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Margins, competition, and monetary policy: Challenges in the banking industry

DOCTORAL DISSERTATION

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A mi familia

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Contents

CHAPTER 1

Introduction

1. Introduction

The outbreak of the financial crisis more than a decade ago, brought about a new environment that has affected the characteristics of the banking business and profitability, margins, cost structure and sources of income of banks. On the one hand, due to the crisis, bank regulations tightened, with greater capital requirements, new liquidity and leverage coefficients, etc., influencing bank behavior. Consequently, the banking playground has significantly changed, becoming more challenging. On the other hand, we face a scenario of reduced margins, associated with persistent low interest rates as a result of the expansionary monetary policies, particularly in Europe, which could hamper profitability. The flattening of the slope of the yield curve erodes the profits derived from the maturity transformation, which is the core of the banking business. Additionally, the negative deposit facility interest rate in the euro area is penalizing banks for excess liquidity, which also directly affects their profitability. Bank profitability is, in some cases, below the cost of raising capital, influencing the stock market price of banks. Therefore, to maintain their profitability, banks are forced to reduce costs (reducing excess capacity) and increase efficiency, as well as to change their income structure, with non-traditional income becoming more important.

In addition, the competitive conditions in the European banking sector have also changed. The need for bank restructuring, with the main objective of reducing the installed capacity, has led to multiple mergers and acquisitions, thus, increasing market concentration; and the concentration of banking activity in a small group of banks may be detrimental to competition. The effects of the new banking playground on competition does not only respond to a smaller number of banks in the market but also to the fact that the closure of branches has also changed the bank branch network, affecting the number and the intensity of contacts between banks. At the same time, progress made towards the banking union (based on three pillars: the single supervisory mechanism, the single resolution mechanism and the European deposit guarantee fund), is aimed at recovering the pre-crisis levels of financial integration but has also resulted in a more competitive scenario. Finally, new technologies are also increasing competition in the financial sector with the emergence of the so-called *fintech* and *big tech* firms that have increased the range of potential suppliers of financial products and services.

Within this context, this thesis focuses on the analysis of the abovementioned aspects: the effect of tighter banking regulations, in terms of capital requirements and deposit insurance, on the net interest margin; the effect of the bank restructuring process on competition; and the effect of the current expansive monetary policy on bank profitability. The study of these issues raises the following three questions: 1) How and to what extent do both the new (increasing) capital requirements and the tightened deposit insurance schemes affect the bank net interest margin? 2) What is the net impact of the current expansionary monetary policy on bank profitability? 3) What

are the effects of bank restructuring and branch closures on competition?

These questions are addressed in the different chapters of this doctoral thesis, although with different dataset approaches according to the needs of the problems. Each question is dealt with in a different chapter (chapters 3 to 5), which have the structure of an academic paper. In order to comply with the requirements of the Universitat de València in relation to the structure of the doctoral thesis, an additional chapter, **chapter 2**, has been included containing a summary of the methods employed which are later described in depth in each chapter.

Following the outline of the methodology in chapter 2, the **third chapter** analyzes, from a theoretical and empirical point of view, the effects of the increase in capital requirements brought in under the Basel III framework and the changes in the deposit insurance scheme on the bank net interest margin. The **fourth chapter** focuses on the effect on the intensity of competition of the restructuring of the Spanish banking sector both in terms of the reduction of banks and their branches. In addition, this chapter measures both the changes in the number and the intensity of multimarket contacts and their impact on competition. Furthermore, the **fifth chapter** examines the effect of the current expansionary monetary policy on the net interest margin and on bank profitability. Finally, the **sixth chapter** sums up the main conclusions reached in each of the chapters and draws some policy implications.

Regulation and bank net interest margins

As mentioned before, since the outbreak of the financial crisis, bank interest margins have been narrowed and the banking environment has experienced some changes. On the one hand, the main central banks have carried out expansive monetary policies to reduce the effect of the crisis, consequently, reducing margins as well. Additionally, competition conditions have also changed due to the reduction in the number of banks and the emergence of new actors in the financial landscape (*fintech*, *big tech*, etc.). Finally, there has been a regulatory tsunami, with new and stricter capital standards, deposit insurance, liquidity coefficients, limits to bank leverage, and so on.

Of all the above factors affecting bank interest margins, the **third chapter** (carried out in co-authorship with Juan Fernández de Guevara) focuses on the effects derived from both the increase in capital requirements, brought in under the Basel III framework, and the changes made in the deposit insurance scheme in preparation for the European deposit guarantee fund. The benefits of increased capital requirements are clear to policymakers: more capital reduces the probability of financial distress, but the effects on bank interest margins need more analytical attention. The benefits of deposit regulation are also clear: a better deposit guarantee scheme increases depositors' trust in banks, thus, reducing the probability of bank runs. However, deposit insurance has also received criticism for introducing moral hazards as it encourages banks to adopt riskier banking practices. The question posed in this chapter is whether banks pass on these increased requirements to their clients in the form of higher interest margins.

Therefore, the **third chapter** of this thesis analyzes bank net interest margins and their determinants, focusing on the effect of

regulatory variables. Taking the theoretical model of Ho and Saunders (1981) as a starting point, together with the extensions of Allen (1988), Angbazo (1997) and Maudos and Fernández de Guevara (2004), a new extension is carried out to include two additional determinants: deposit insurance schemes and capital requirements. This theoretical contribution has been empirically contrasted using a panel data comprising banks from 31 OECD countries for the period 2000-2014. The fact that it covers a sufficiently long period, including pre- and post-crisis sub-periods, has allowed us to control for the effect of the crisis on net interest margins.

The results found in this chapter reveal that the net interest margin responds mainly to market power, average operating costs, liquid reserves, capital requirements and deposit insurance; as well as other control variables that are usually not included in the theoretical model, such as, implicit interest payments and efficiency in management. Therefore, the empirical analysis does not allow to dismiss the importance of the theoretical extension carried out in the chapter. In addition, the crisis has shown a negative and significant effect on the margin.

In general, when the determinants remain constant, greater capital and deposit insurance requirements result in higher margins. This conclusion is particularly relevant since, it is widely known that regulators seek to ensure financial stability by imposing stricter requirements on banks. However, the results indicate that banks respond by increasing their net interest margins to offset the cost of the greater capital they are required to maintain. This implies that the cost of stricter regulations is finally borne by consumers. Although interest rates are currently low, if the pace of monetary policy changes

and becomes more restrictive, bank margins will increase due to new restrictions imposed by regulations. In summary, the increase in regulatory standards introduced after the outbreak of the crisis implies greater bank stability. However, the cost of this greater stability will be transferred to bank customers in the form of higher interest rates on their loans or lower interest rates on their deposits.

Effects of bank restructuring on the multimarket banking competition

Since 2008, competitive banking conditions have changed due to bank restructuring, reduction of the installed capacity, consolidation, emergence of new rivals such as *fintech* and *big tech*, etc. The question here is to test the effect of these changes on the intensity of competition in the banking markets.

The **fourth chapter** (carried out in co-authorship with Juan Fernández de Guevara and Joaquín Maudos) focuses on one of these dimensions, namely the fact that the reduction in the number of branches has implied a change in the number of geographic markets where banks meet, that is, the multimarket contact. However, not only has the number of multimarket contacts changed but also their intensity, since the number of branches with which the banks meet has also changed. These facts may have affected banking competition, which is precisely the topic of the **fourth chapter**.

The **fourth chapter** analyzes the determinants of the market power of the Spanish banking sector during the period 2006-2017, focusing on the effect of the evolution on the multimarket contacts and their intensity. For this purpose, the multimarket contact measure proposed by Coccorese and Pellecchia (2009), which considers the

number of multimarket contacts among banks, is initially used. A new measure of the intensity of the multimarket contacts is also developed. This new bank indicator not only measures the number of contacts of a given bank with its competitors in the different markets they meet, but also whether the bank's situation, in terms of branches, is dominant or weak with respect to their rivals. With this analysis, we are allowed to test the effect of branch closures, as a result of the bank restructuring process, on competition in the Spanish banking sector.

The results indicate that once the intensity of multimarket contacts is considered, i.e. with the new proposed indicator, evidence of tacit collusion is found. Since the closure of bank branches in Spain has reduced the number of multimarket contacts and has increased the intensity of the remaining ones, it should have resulted in greater market power. Therefore, if the trend does not change or is not offset by other pro-competitive factors, welfare losses will continue. The results also show that, in general, banks that are more efficient and better capitalized, enjoy greater market power.

Low interest rates and the slope of the yield curve: effects on margins and profitability

The accommodative monetary policy, carried out by the main central banks in order to combat the effects of the financial crisis that erupted in 2008, has led to an extended period of low –or even negative– interest rates. The potential side effects of low interest rates on bank profitability are especially relevant considering that, in some cases, such as the European banking sector, bank profitability is below the cost of raising capital, affecting negatively the price of banks in the stock markets. This low profitability is due to several reasons,

such as, the high volume of non-performing assets, regulatory requirements, competition from *fintech* and *big tech*, etc. This situation brings to light the pressure of low interest rates to net interest margins. In addition, in the case of European banks, the negative interest rate on the deposit facility is penalizing banks for excess liquidity, directly affecting their income statement and, thus, their profitability.

Low interest rates maintained over an extended period may reduce banks' margins, affecting their profitability. With negative interest rates, the existence of an effective lower limit on the remuneration of deposits (as customers are not expected to accept a negative deposit interest rate) makes it difficult to pass on the drop-in interest rates to the interest on deposits and thus the financial margins narrow. In this context, the **fifth chapter** makes an in-depth analysis of the link between monetary policy and bank profitability, focusing on the effect of both the interest rate levels and the yield curve on profitability and on net interest margins.

Therefore, the **fifth chapter** studies the effect of the current expansionary monetary policy on bank profitability using a sample of banks from 31 OECD countries during the period 2000-2017, which includes the pre-crisis sub-period, the crisis sub-period and the years of the subsequent economic recovery.

The results of this chapter show that the expansionary monetary policy measures adopted by numerous central banks have a negative impact on net interest margins and, therefore, on bank profitability, through low interest rates and the flattening of the yield curve. In both cases of interest margins and profitability, the impact of the interest rates and the yield curve slope is non-linear. This reflects, among

other things, that when interest rates are low, since deposit rates cannot fall below zero, the difference between the market rate and the deposit rate is reduced, this reduction being greater as the interest rate decreases. The same applies for the yield curve, the flatter the slope of the yield curve, the greater the reduction of the net interest margin and profitability. Therefore, the problem of low profitability in certain banking sectors will persist as long as the current scenario of low interest rates continues, which may also affect financial stability.

CHAPTER 2

Methodology

2. Methodology

This chapter briefly describes the methodology used to address the questions raised in each chapter to accomplish with the Universitat de València requirements in terms of the doctoral thesis structure[1]. Accordingly, the specific methodology will be explained in detail in each chapter. Each of the following three chapters is self-contained, with its own introduction, literature review, methodology, results and conclusions.

As mentioned above, the **third chapter** analyzes the determinants of net interest margin with a focus on the impact of capital regulation and deposit insurance. This analysis aims to measure to what extent both the new increased capital requirements and the new deposit insurance scheme affect the bank net interest margin. To do so, we extend the theoretical model of Ho and Saunders (1981), together with the extensions of Allen (1988), Angbazo (1997) and Maudos and Fernández de Guevara (2004), of the net interest margin determinants to explicitly include both capital requirement and the deposit insurance premium. After this extension, the potential net interest margin determinants are: market power, risk aversion, the size of transactions, the average cost of transactions, the volatility of the

[1] Article 1.4 of the *Reglamento sobre depósito, evaluación y defensa de la tesis doctoral*, approved by the Consejo de Gobierno of June 28, 2016 and amended on October 31, 2017.

money market, credit risk, the interaction between these risks, the deposit insurance premium and the capital requirements.

The results from the theoretical model are tested using a panel data from 31 OECD countries between 2000 and 2014. The empirical approach consists of regressing the net interest margin against the determinants already described, along with other variables usually included in the previous empirical literature: liquidity reserves, implicit interest payments, management efficiency and GDP growth. One lag of the dependent variable is also included as an explanatory variable to capture the inertia effects of the net interest margin.

The empirical estimation adopts the two-step GMM dynamic system panel estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The estimation also includes time effects to reflect the impact of particular shocks in each year affecting the dependent variable.

Taking all the above into account, the main estimated equation that models the net interest margin of a bank *i* in year *t* is the following:

$$\begin{aligned} NIM_{it} = {} & \beta_0 + \beta_1 NIM_{it-1} + \beta_2\, Implicit\ interest\ payments_{it} \\ & + \beta_3 Efficiency_{it} + \beta_4 Lerner\ index \\ & + \beta_5 Interest\ rate\ risk_{it} + \beta_6\, Credit\ risk_{it} \\ & + \beta_7\, Risk\ covariance_{it} + \beta_8 Loan_{it} + \beta_9 Risk\ aversion_{it} \\ & + \beta_{10} Average\ cost_{it} + \beta_{11} Reserves_{it} \\ & + \beta_{12} Capital\ stringency_{it} \\ & + \beta_{13} Deposit\ insurance_{it} + \beta_{14} GDP\ growth_{it} + \varepsilon_i + \alpha_t + u_{it} \end{aligned} \tag{2.1}$$

where ε_i are individual effects, α_t are time effects and NIM_{it} is the net interest margin of bank *i* in year *t*.

In addition, some robustness tests using alternative measures for some variables, as well as alternative samples, are performed.

The **fourth chapter** of this thesis investigates the determinants of market power of the Spanish banking sector during the period 2006-2017, focusing on the effect of the evolution of the multimarket contact, as well as its intensity. The aim is to test the effects on competition of banking closures due to the bank restructuring process. To do so, we use different multimarket contact indexes. On the one hand, we use a multimarket contact index from Coccorese and Pellecchia (2009). On the other hand, we propose a new multimarket contact indicator that not only considers the existence of contacts between banks, but also the intensity of these contacts. Intensity is measured through the dominance/weakness situation of banks with respect to their rivals, in terms of number of branches, in the markets where they coincide.

In the empirical analysis, the dependent variable is the Lerner index corrected by credit risk. As potential determinants of the Lerner index we include those considered by the standard Monti-Klein model for the case of oligopolistic competition that shows that the market power depends on the number of rivals and the elasticity of demand. Furthermore, following a conjectural variation approach, in which firms form expectations (conjectures) about the reactions (variations) of the others, these variations would also be part of the determinants of market power. In addition, the standard model has been extended in other papers of the previous literature with the aim of incorporating additional explanatory variables of market power. Thus, Corvosier and Gropp (2002), Fernández de Guevara et al. (2005) and Fernández de Guevara and Maudos (2007), among others, show that the market

power depends on the specific variables of the bank, market concentration and the elasticity of demand. Therefore, as determinants of the Lerner index we include a multimarket contact indicator / intensity of the multimarket contact indicator, market concentration, liquidity ratio, efficiency, percentage of loans over total assets, capitalization ratio and GDP growth. The multimarket contact indicators are built using information of each bank branch in Spain. The relevant market considered for the multimarket indicator is the post code.

In some specifications, the lagged dependent variable is included as explanatory variable to capture the inertia effects of the Lerner index of market power. In these cases, the empirical estimation adopts the two-step system GMM dynamic panel estimator. All the estimations include time effects to reflect the impact of specific unobserved shocks in each year affecting the dependent variable.

In addition, a robustness test using an alternative sample, that only includes the multimarket banks, is performed.

The **fifth chapter** analyzes the effect of the monetary policy on bank profitability. More specifically it focuses on the impact of policy interest rates and the slope of the yield curve. The question to be addressed is which is the net impact of the current expansionary monetary policy on bank profitability.

A panel of data from 31 OECD countries over the period 2000-2017 is used to empirically analyze this topic. As dependent variables two alternative variables are used: net interest margin (difference between revenue and financial costs) and return of assets (ROA), both expressed as a percentage of total assets. As potential determinants of the alternative dependent variables, the following

variables commonly used in the related literature are included: the short-term interest rate and the slope of the yield curve as monetary policy indicators, and the GDP real growth rate. Additional bank specific characteristics include market power (corrected by credit risk), credit risk, bank size, banks' degree of risk aversion, operating costs (only for the case in which the dependent variable is the net interest margin, since in the case of ROA this variable is an identity variable), implicit payments, liquidity reserves and an efficiency indicator. An indicator of uncertainty about market conditions, the money market interest rate volatility, is also included, together with the interaction between this risk and the credit risk.

The empirical approach consists of regressing each dependent variable (net interest margin and ROA) against the aforementioned potential determinants. In each regression one lag of the dependent variable is included as an explanatory variable to capture the inertia effects. The empirical estimation adopts the two-step system GMM dynamic panel estimator. The estimation also includes time effects to reflect the impact of specific unobserved shocks in each year affecting the dependent variables.

Taking all the above into account, the estimated equations that models the net interest margin and ROA of a bank i in year t are respectively the following:

$$
\begin{aligned}
NIM_{it} = {} & \beta_0 + \beta_1 NIM_{it-1} + \beta_2\, Short\ term\ interest\ rate_{it} \\
& + \beta_3\, Short\ term\ interest\ rate_{it}^2 \\
& + \beta_4\, Slope\ of\ the\ yield\ curve_{it} \\
& + \beta_5\, Slope\ of\ the\ yield\ curve_{it}^2 + \beta_6\, Lerner\ index_{it} \\
& + \beta_7\, Credit\ risk_{it} + \beta_8\, Interest\ rate\ risk_{it} \\
& + \beta_9\, Risk\ interaction_{it} + \beta_{10}\, Size_{it} \\
& + \beta_{11}\, Risk\ aversion_{it} + \beta_{12}\, Operating\ costs_{it} \\
& + \beta_{13}\, Implicit\ payments_{it} + \beta_{14}\, Reserves_{it} \\
& + \beta_{15}\, Efficiency_{it} + \beta_{16}\, GDP\ growth_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{2.2}
$$

$$
\begin{aligned}
ROA_{it} = {} & \beta_0 + \beta_1 ROA_{it-1} + \beta_2\, Short\ term\ interest\ rate_{it} \\
& + \beta_3\, Short\ term\ interest\ rate_{it}^2 \\
& + \beta_4\, Slope\ of\ the\ yield\ curve_{it} \\
& + \beta_5\, Slope\ of\ the\ yield\ curve_{it}^2 + \beta_6\, Lerner\ index_{it} \\
& + \beta_7\, Credit\ risk_{it} + \beta_8\, Interest\ rate\ risk_{it} \\
& + \beta_9\, Risk\ interaction_{it} + \beta_{10}\, Size_{it} \\
& + \beta_{11}\, Risk\ aversion_{it} + \beta_{12}\, Implicit\ payments_{it} \\
& + \beta_{13}\, Reserves_{it} + \beta_{14}\, Efficiency_{it} \\
& + \beta_{15}\, GDP\ growth_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{2.3}
$$

where ε_i are individual effects, α_t are time effects, NIM_{it} is the net interest margin of bank *i* in year *t,* and ROA_{it} is the ratio of profits to total assets of bank *i* in year *t*.

CHAPTER 3

Determinants of Net Interest Margin: The Effect of Capital and Deposit Requirements

3. Determinants of Net Interest Margin: The Effect of Capital and Deposit Requirements

3.1. Introduction

Since the outbreak of the financial crisis a decade ago, several factors have narrowed bank interest margins. Central banks have carried out expansive monetary policies to reduce the effects of the crisis, resulting in an extended period of low (or even negative) interest rates. In this context of low interest rates, bank margins and profitability have been eroded and, in an effort to maintain profitability, non-traditional income has become more important. Competition conditions in bank markets have also changed. In Europe, the progress towards banking union with a single supervisory mechanism, a single resolution mechanism and moves to implement a European deposit guarantee fund could also affect bank margins through increased competition. Concentration has generally increased in most banking sectors since the crisis, which may generate an increase of market power. Finally, one of the main consequences of the crisis has been the ensuing regulatory tsunami. Bank regulation has changed dramatically at a global level with the introduction of new and stricter

capital standards, deposit insurance, liquidity coefficients, limits to bank leverage, and so on.

The main objective of this chapter is to analyze the effects of the abovementioned changes in the banking environment on the interest margin and its determinants. Specifically, we examine the effects of the changes in two areas of regulation is examined: capital requirements and deposit insurance. Of all the above factors affecting bank interest margins, the increase in capital requirements brought in under the Basel III framework, and changes to the deposit insurance scheme in preparation for the European deposit guarantee fund have not received attention in the literature. The benefits of increased capital requirements are clear to policymakers: more capital reduces the probability of financial distress, but the effects on banks' margins have received scant analytical attention. The benefits of deposit regulation are also clear: a better deposit guarantee scheme increases depositors' confidence in the bank, reducing the probability of bank runs. However, deposit insurance has also received criticism for introducing moral hazard, by encouraging banks to adopt riskier banking practices. Analysis of its effects on bank margins is also scarce.

The previous literature on net interest margins has underlined the importance of factors such as the degree of competition, credit and market risks or average operating costs, to name a few. Ho and Saunders's (1981) seminal model—the most widely used model to analyze bank interest margins—and its subsequent extensions show that the interest margin depends on the degree of risk aversion, market structure, average size of bank transactions, interest rate risk, credit risk, the interaction between these two risks, operating costs, and

maturity transformation. However, to date, capital requirements and the deposits insurance scheme have rarely been included in theoretical models or empirical applications as determinants of the bank net interest margin. Using alternative models to that of Ho and Saunders (1981), Zarruk (1989), Zarruk and Madura (1992) and Wong (1997) examined the relationship between capital regulation and the optimal bank interest margin, and in the first two papers, the relationship between this margin and the deposit insurance premium. The results from this family of models are ambiguous, and therefore conclusions are mixed. Bartholdy *et al*. (1997), Barth *et al.* (1997), Demirgüç-Kunt and Huizinga (1999), Demirgüç-Kunt and Detragiache (2002) and Carapella and Giorgio (2004) consider deposit insurance in their analysis of net interest margin and bank profitability and discuss the theoretically ambiguous effect of deposit insurance on each of these variables in their papers.

Our goal in this chapter is to study the effects of two types of bank regulation on bank net interest margin: the role of capital requirements and the deposit insurance scheme. Our contribution to the literature is twofold. Firstly, we extend the Ho and Saunders (1981) framework to include the capital requirement, as well as some deposit insurance features. In this model banks maximize the utility of shareholder wealth by selecting an optimal margin between the interest rates on loans and deposits. However, the existence of a minimum capital requirement implies that banks maximize their wealth above the minimum level they are obliged to hold in accordance with their risk portfolio. As in the previous versions of the model developed in the literature, the determinants of the pure interest margin are market structure, degree of risk aversion, size of banking

operations, average operating costs, credit risk, interest rate risk and the interaction between these two risks. The model is extended in this chapter to include two additional factors: capital requirements and the deposit insurance premium.

The second contribution of the chapter is related to the empirical analysis. The literature on the empirical effect of capital requirement and the deposit insurance scheme on bank margins is scarce and inconclusive. We shed some light on this issue using a panel of banks from 31 OECD countries, during the period between 2000 and 2014. This period is particularly relevant, since it includes the years of expansion (until 2008) and the subsequent crisis years. To the best of our knowledge, the relationship between net interest margin and both capital requirements and deposit insurance characteristics has not previously been estimated for such a long (and recent) period using data for a large number of banks in many countries. The proxies of the capital requirements and the deposit insurance regulations are also an innovative way to explain the net interest margin.

Our main finding suggests that capital and deposit insurance regulations have a significant positive impact on bank net interest margins. Therefore, holding the rest of determinants constant, higher capital requirements and higher deposit insurance requirements are associated to higher net interest margin. This conclusion is particularly relevant as, in general, regulators aim to guarantee financial stability by imposing stricter requirements on banks. Our results show that banks respond by increasing their margins to compensate for the higher capital they are obliged to hold. This means that the bank's customers will ultimately bear the costs of these stricter regulations.

The rest of the chapter is organized as follows. Section 3.2 reviews the previous related literature. Section 3.3 lays out the theoretical model. The data, the variables used in the empirical analysis and the methodology are described in Section 3.4. Section 3.5 presents the empirical results and, finally, Section 3.6 outlines the main conclusions and the policy implications of our study.

3.2. Literature Review

One of the most commonly used frameworks to analyze the evolution of interest margins is Ho and Saunders' (1981) model. In this model, a bank is viewed regarded as a risk-averse dealer in the credit market, acting as an intermediary between demanders and suppliers of loanable funds. This model posits that the optimum "pure" bank interest margin depends on the banking market structure, the degree of risk aversion, the average size of bank transactions and the interest rate volatility (market risk). The Ho and Saunders (1981) model was expanded to incorporate other determinants of net interest margin. McShane and Sharpe (1985) changed the source of interest rate risk, placing it in the uncertainty of money markets, instead of the interest rates of loans and deposits as in the seminal model. Allen (1988) incorporated different types of loans. According to this extension, margins can be reduced when the cross-elasticity of demand among banking products is considered. Angbazo (1997) included credit risk in addition to interest rate risk. Maudos and Fernández de Guevara (2004) extended the model to include operating costs. Carbó and Rodríguez (2007b) developed the theoretical model considering not

only the determinants of net interest margins, but also the determinants of the margin derived from non-traditional activities. Finally, Entrop *et al*. (2015) modified the model by including different types of assets in terms of their maturity.

Recent empirical applications of the model include Williams (2007), who follows McShane and Sharpe (1985) to analyze the determinants of net interest margin in Australia, considering the period between 1989 and 2001 and the differences between domestic and foreign banks. Following Carbó and Rodríguez (2007b), Lepetit *et al.* (2008) empirically analyze the effect of non-traditional fee-based activities on net interest margins. Nguyen (2012) focuses on the determinants of net interest margin and the determinants of the margin derived from non-traditional activities. Other studies have used extensions of the Ho and Saunders' (1981) model to analyze bank margins in specific countries or geographical areas. This list includes, among others, Kannan, *et al.* (2001) for India; Fernández de Guevara (2004) for Spanish banks; Doliente (2005) for four southeast Asian countries; Liebeg and Schwaiger (2006) for Austria; Claeys and Vander Vennet (2008) for Central and Eastern Europe, in a comparison with countries in western Europe; Zhou and Wong (2008) for Chinese commercial banks; Maudos and Solís (2009) for Mexico; Lin *et al.* (2012) for Asian banks, including the effect on bank diversification; Saad and Moussawi (2012) for Lebanon; Amuakwa-Mensah and Marbuah (2015) for the case of Ghana; and Birchwood *et al*. (2017) for Central America and the Caribbean. Kannan *et al.* (2001) include regulatory requirement variables with a positive effect on the net interest margin, and Birchwood *et al.* (2017) include

variables related to the regulatory environment (entry requirements, reporting transparency and the foreign bank share of banking assets).

However, the Ho and Saunders (1981) framework is not the only model used to analyze banks' net interest margin. Zarruk (1989) models the interest margin by considering explicitly the capital requirement and the deposit insurance premium. His model also considered the uncertainty (market risk) and the risk aversion as applied by Ross (1981). Zarruk and Madura (1992) extended this model, using credit risk rather than Zarruk's (1989) previous interest risk, and Wong (1997) extended this framework but included multiple sources of uncertainty (interest risk and credit risk), operating expenses and capital requirement. The results from this family of models are ambiguous and they depend on the risk-averse behavior as described in Ross (1981).

Other studies analyzing the effect of the regulation of deposit insurance on interest margin also find an ambiguous effect. On the one hand, there is a negative relationship between the amount of deposits guaranteed by the insurance scheme and the interest rate paid on deposits, considering that the risk assumed by depositors is lower when the deposits are guaranteed. In this case, deposit insurance would increase the interest margin. On the other hand, the existence of the deposit insurance might encourage banks to carry out riskier lending strategies (Merton, 1977, Keeley, 1990), so that bank creditors could demand a higher interest rate. Therefore, this moral hazard problem would reduce the net interest margin and the profitability. Even if a bank does not adopt a riskier strategy, margins can be reduced by considering the effect of competition, since in this case small banks could compete with larger banks in capturing deposits.

The reason is simple: in the absence of deposit insurance, depositors would prefer to deal with large banks as they are expected to be too large to fail. In this context, using data for 13 OECD countries, from 1985 to 1990, Bartholdy *et al.* (1997) estimate the relationship between the existence of explicit deposit insurance and deposit interest rates, finding that deposit insurance reduces the deposit interest rate. Barth *et al*. (1997) found no significant impact in their analysis of the effect of explicit deposit insurance on banks' return on equity (ROE) for a sample of 19 developed countries in 1993. Demirgüç-Kunt and Huizinga (1999) analyzed the margin and profitability of 80 countries from 1988 to 1995. Their results suggest that the existence of explicit deposit insurance has a negative impact on bank interest margins. Demirgüç-Kunt and Detragiache (2002), in their study for 61 countries during the period 1980-1997, show the positive relationship between the existence of explicit deposit insurance and the probability of banking crises, due to the riskier strategy adopted by banks. Carapella and Giorgio (2004) estimate the relationship between the deposit insurance and bank interest rate for a set of 55 countries during the period 1996-2001, finding that deposit insurance increases the loan-deposit interest rate spread. This effect is related to presence of moral hazard that encourages banks to engage in riskier lending activities with higher loan rates.

3.3. Theoretical Model

The starting point for analyzing the determinants of the interest margin, especially the effect of capital and deposit requirements, is the model of Ho and Saunders (1981) and the extensions of Allen (1988), Angbazo (1997) and Maudos and Fernández de Guevara (2004). In the Ho and Saunders framework, the bank is viewed as a risk-averse dealer in the credit market, acting as an intermediary between demanders and suppliers of funds. The planning horizon is a single period, at the beginning of which the bank sets interest rates that remain constant over the whole period. The bank sets interest rates on loans (r_L) and deposits (r_D) as a margin relative to the interest rate of the money market (r), i.e.:

$$r_D = r - a \tag{3.1}$$

$$r_L = r + b \tag{3.2}$$

where a and b are the margins relative to the money market interest rate set by the banks for deposits and loans, respectively. Therefore, the unit margin or spread "s" can be expressed as the difference between the interest rates of loans and the interest rate of deposits:

$$s = r_L - r_D = a + b \tag{3.3}$$

Once the interest rates are fixed, the volume of loans granted and deposits accepted by the bank is determined by the corresponding loan and deposit demand functions.

Banks set interest rates so that they maximize the expected utility of their wealth. The initial wealth of the bank is determined by the difference between its assets (loans (L) and money market assets (M)) and its liabilities (deposits (D)). Furthermore, banks must assume the production costs of granting loans $Exp(L_0)$ and capturing deposits $Exp(D_0)$:

$$\begin{aligned} W_0 &= L_0 - D_0 + M_0 - \big(Exp(L_0) + Exp(D_0)\big) \\ &= I_0 + M_0 - Exp(I_0) \end{aligned} \tag{3.4}$$

where $I_0 = L_0 - D_0$ is the net balance of loans and $Exp(I_0) = Exp(L_0) + Exp(D_0)$ is the cost associated with the net balance of loans.

Banks face two types of risks. One is the interest rate risk, as the yield money market interest rate r is uncertain. We assume that it is distributed as a random variable $Z_M \sim N(0, \sigma_M^2)$. The other is the credit risk, as the profitability of loans is uncertain and we also assume that it is distributed as a random disturbance $Z_L \sim N(0, \sigma_L^2)$. In order to take into account the interaction between risks, the joint distribution is assumed to be bivariate normal with non-null covariance (σ_{ML}).

Additionally, banks must allocate a percentage of their deposits (premium) to the Deposit Insurance Fund. The objective of this fund is to guarantee deposits in cash and securities or other financial instruments, minimizing the impact of bank bailouts on the taxpayer and preventing bank runs, when necessary. Merton (1977) proposed that the actuarial price of the deposit insurance premium can be approximated by the Black-Scholes (1973) formula for the valuation of a put option, obtaining that the premium depends on the proportion

of assets and deposits and the volatility of the bank's assets. Following this result, we assume that the deposit insurance premium (d) is distributed as a random disturbance $d \sim N(d, f(\sigma_L^2))$, which for simplicity we assume that $f(\sigma_L^2)$ is a linear function, specifically: $d \sim N(d, d\sigma_L^2)$.

With all these assumptions, if there is no additional loan or deposit the final wealth of the bank will be:

$$\begin{aligned} W_T &= (1 + r_I + Z_I)\, I_0 + (1 + r + Z_M)\, M_0 - Exp(I_0) - dD_0 \\ &= I_0 + I_0 r_I + I_0 Z_I + M_0 + M_0 r + M_0 Z_M - Exp(I_0) - \mathrm{d}D_0 \\ &= W_0(1 + r_w) + I_0 Z_I + M_0 Z_M - Exp(I_0) - \mathrm{d}D_0 \end{aligned} \tag{3.5}$$

where $r_I = \frac{r_L L_0 - r_D D_0}{I_0}$ is the average profitability of the net credit inventory, $r_w = r_I \frac{I_0}{W_0} + r \frac{M_0}{W_0}$ is the average profitability of bank's initial wealth and $Z_I = Z_L \frac{L_0}{I_0} + Z_D \frac{D_0}{I_0} = Z_L \frac{L_0}{I_0}$ is the average risk of the net credit inventory[2].

Banks must also comply with the minimum capital requirement (kL_0), which is imposed to ensure that they do not participate in investments that may increase their risk of bankruptcy and they have enough capital in case of possible economic shocks. This requirement is defined as the minimum percentage of the net wealth that banks must maintain to ensure their solvency, in accordance with the content of pillar 1 of Basel III. The required minimum capital is expressed as a

[2] It is assumed that the capturing of deposits is not subject to any risk, $\mathrm{Z_D} \frac{\mathrm{D_0}}{\mathrm{I_0}} = 0$.

percentage of the bank's risky assets (loans)[3]. Banks need to hold capital above the minimum requirement. Therefore, a bank will maximize its wealth above the minimum requirement, as they are not allowed to hold less capital than the requirement. Thus, the equation of the wealth of the bank used in the previous literature by Ho and Saunders (1981), Angbazo (1997) or Maudos and Fernández de Guevara (2004), among others, has been rewritten in terms of the bank capital buffer (W_B), discounting the capital requirement of the bank's capital:

$$\begin{aligned} W_B &= W_T - kL_0 \\ &= W_0(1 + r_w) + I_0 Z_I + M_0 Z_M - Exp(I_0) - dD_0 \ - kL_0 \end{aligned} \tag{3.6}$$

That is, a bank's objective function will be based on the excess of wealth that it has above the capital requirement in order to operate in the market according to its stock of risky assets (loans).

Banks are maximizers of expected utility[4]. Following common procedure in the previous literature, the bank's utility function is approximated using a second-order Taylor expansion around the expected level of wealth, i.e., the capital buffer ($\overline{W}_B = E(W_B)$)[5]:

$$\begin{aligned} EU(W_B) = U(\overline{W}_B) + U'(\overline{W}_B)\, E(W_B - \overline{W}_B) \\ + \frac{1}{2}\, U''(\overline{W}_B)\, E(W_B - \overline{W}_B)^2 \end{aligned} \tag{3.7}$$

[3] We work under the assumption that all loans are risky.

[4] It is assumed that the bank is risk averse: $U'(W_B) > 0$, $U''(W_B) < 0$.

[5] $\overline{W}_B = E(W_B) = E(W_0(1 + r_w) + L_0 Z_L + M_0 Z_M - dD_0 - kL_0) = W_0(1 + r_w) - Exp(I_0) - dD_0 - kL_0$.

Therefore, considering that $W_B - \bar{W}_B = L_0 Z_L + M_0 Z_M$, the expected utility of final wealth above the capital requirement is given by the following expression:

$$\begin{aligned} EU(W_B) &= U(\bar{W}_B) + U'(\bar{W}_B)\, E(L_0 Z_L + M_0 Z_M) \\ &+ \frac{1}{2}\, U''(\bar{W}_B)\, E(L_0 Z_L + M_0 Z_M)^2 \\ &= U(\bar{W}_B) + \frac{1}{2}\, U''(\bar{W}_B)\, (L_0^2\ \sigma_L^2 + M_0^2\ \sigma_M^2 + 2 L_0 M_0 \sigma_{LM}) \end{aligned} \tag{3.8}$$

To develop the model, we analyze the effects of the final wealth above the capital requirement of the arrival of a new deposit or the request for a new loan.

If the bank grants a new loan, Q_L, it will receive $r_L Q_L = (r + b + Z_L) Q_L$ in interest payments. If it does not receive any additional deposits, it needs to finance this new loan in the money market and it will have to pay $(r + Z_M) Q_L$. Additionally, granting credits implies that the bank incurs additional production costs that depend on the volume of loan granted, $Exp(Q_L)$. Furthermore, banks must meet the capital requirement associated with this new loan, kQ_L, that is, the capital buffer is reduced due to the capital requirement associated with the new loan granted. With these assumptions, the final available wealth after the credit granted ($W_B|loan$) will be:

$$\begin{aligned} W_B|loan \ &= W_0(1 + r_w) + (L_0 + Q_L) Z_L + b Q_L \\ &+ (M_0 - Q_L) Z_M - Exp(L_0 + Q_L) - k(L_0 + Q_L) - \mathrm{d}D_0 \end{aligned} \tag{3.9}$$

and the expected utility will be:

$$\begin{aligned} EU(W_B|loan\,) = {} & U(\bar{W}_B) + U'(\bar{W}_B)\,[bQ_L - Exp(Q_L) - kQ_L] \\ & + \frac{1}{2}\,U''(\bar{W}_B)\,[(bQ_L - Exp(Q_L) - kQ_L)^2 \\ & + (L_0 + Q_L)^2\,\sigma_L^2 + (M_0 - Q_L)^2\,\sigma_M^2 \\ & + 2(L_0 + Q_L)(M_0 - Q_L)\,\sigma_{LM}] \end{aligned} \tag{3.10}$$

Therefore, the increase in the expected utility associated with the new loan will be:

$$\begin{aligned} \Delta EU(W_B|loan) &= EU(W_B|loan) - EU(W_B) \\ &= U'(\bar{W}_B)\,[bQ_L - Exp(Q_L) - kQ_L] \\ &+ \frac{1}{2}\,U''(\bar{W}_B)\,[(bQ_L - Exp(Q_L) - kQ_L)^2 \\ &+ (Q_L + 2L_0)Q_L\sigma_L^2 + (Q_L - 2M_0)Q_L\sigma_M^2 \\ &+ 2(M_0 - L_0 - Q_L)\,Q_L\sigma_{LM}] \end{aligned} \tag{3.11}$$

Similarly, if the bank accepts a new deposit, Q_D, it will have to pay $r_D Q_D$. If the bank does not grant any additional loans, the new deposit will be invested in the money market, which offers a return $(r + Z_M)Q_D$. As with loans, accepting deposits implies that the bank incurs production costs that depend on the volume of deposits, $Exp\,(Q_D)$. Furthermore, a percentage d of the new deposit corresponds to the Deposit Insurance Fund contribution. With these assumptions, the final available wealth after the deposit is accepted $(W_B|deposit)$ will be:

$$\begin{aligned} W_B|deposit \; = {} & W_0(1 + r_w) + L_0 Z_L + (M_0 + Q_D)Z_M \\ & + aQ_D - Exp(I_0) - Exp(Q_D) - kL_0 - d(D_0 + Q_D) \end{aligned} \tag{3.12}$$

and the expected utility will be:

$$
\begin{aligned}
EU(W_B|deposit) = {} & U(\bar{W}_B) \\
& + U'(\bar{W}_B)\,[aQ_D - Exp(Q_D) - dQ_D] \\
& + \frac{1}{2}\,U''(\bar{W}_B)\,[\left(aQ_D - Exp(Q_D)\right)^2 + (L_0 - dQ_D)^2\,\sigma_L^2 \\
& + (M_0 + Q_D)^2\,\sigma_M^2 + 2(L_0 - dQ_D)(M_0 + Q_D)\,\sigma_{LM}]
\end{aligned}
\tag{3.13}
$$

Therefore, the increase in the expected utility associated with the new loan will be:

$$
\begin{aligned}
\Delta EU(W_B|deposit) = {} & EU(W_B|deposit) - EU(W_B) \\
& = U'(\bar{W}_B)\,[aQ_D - Exp(Q_D) - dQ_D] \\
& + \frac{1}{2}\,U''(\bar{W}_B)\,[\left(aQ_D - Exp(Q_D)\right)^2 + (dQ_D - 2dL_0)Q_D\sigma_L^2 \\
& + (Q_D + 2M_0)Q_D\sigma_M^2 + 2(L_0 - dM_0 - dQ_D)\,Q_D\sigma_{LM}]
\end{aligned}
\tag{3.14}
$$

Following common practice with the model of Ho and Saunders (1981) and the other models, we assume that loans and deposits arrive randomly at the bank at the beginning of the period, according to Poisson processes that depend on the parameters *a* and *b*. Therefore, the probability of granting a new loan or accepting a new deposit is the following:

$$P_L = \alpha_L - \beta_L b \tag{3.15}$$

$$P_D = \alpha_D - \beta_D a \tag{3.16}$$

The bank's objective function is conditional on the occurrence of, at least, a single transaction of each. Therefore, the maximization problem is as follows:

$$
\begin{aligned}
&Max_{a,b}\, EU(\Delta W_B) \\
&\quad = P_D\, \Delta EU(W_B|deposit) + P_L\, \Delta EU(W_B|loan) \\
&\quad = (\alpha_D - \beta_D a)\Big[U'(\bar{W}_B)\,[aQ_D - Exp(Q_D) - dQ_D] \\
&\quad + \frac{1}{2}\, U''(\bar{W}_B)\,[(aQ_D - Exp(Q_D))^2 \\
&\quad + (dQ_D - 2dL_0)Q_D\sigma_L^2 + (Q_D + 2M_0)Q_D\sigma_M^2 \\
&\quad + 2(L_0 - dM_0 - dQ_D)\, Q_D\sigma_{LM}]\Big] \\
&\quad + (\alpha_L - \beta_L b)\,\Big[U'(\bar{W}_B)\,[bQ_L - Exp(Q_L) - kQ_L] \\
&\quad + \frac{1}{2}\, U''(\bar{W}_B)\,[(bQ_L - Exp(Q_L) - kQ_L)^2 \\
&\quad + (Q_L + 2L_0)Q_L\sigma_L^2 + (Q_L - 2M_0)Q_L\sigma_M^2 \\
&\quad + 2(M_0 - L_0 - Q_L)\, Q_L\sigma_{LM}]\Big]
\end{aligned}
\tag{3.17}
$$

The first order conditions with respect to a and b are as follows[6]:

$$
\begin{aligned}
&\frac{\partial EU(\Delta W_B)}{\partial a} = -\beta_D\Big[U'(\bar{W}_B)\,[aQ_D - Exp(Q_D) - dQ_D] \\
&+ \frac{1}{2}\, U''(\bar{W}_B)\,[(Q_D - 2L_0)dQ_D\sigma_L^2 + (Q_D + 2M_0)\, Q_D\, \sigma_M^2 \\
&+ 2(L_0 - dM_0 - dQ_D)\, Q_D\, \sigma_{LM}]\Big] + (\alpha_D - \beta_D a)[U'(\bar{W}_B)\, Q_D] = 0
\end{aligned}
\tag{3.18}
$$

[6] It is assumed, following Ho and Saunders (1981) and subsequent extensions of their seminal model, that $(aQ_D - Exp(Q_D))^2 = 0$ and $(bQ_L - Exp(Q_L) - kQ_L)^2 = 0$.

So that:

$$a = \frac{1}{2}\frac{\alpha_D}{\beta_D} + \frac{1}{2}\frac{Exp(Q_D)}{Q_D} + \frac{1}{2}d - \frac{1}{4}\frac{U''(\bar{W}_B)}{U'(\bar{W}_B)}((Q_D - 2L_0)d\sigma_L^2 + (Q_D + 2M_0)\sigma_M^2 + 2(L_0 - dM_0 - dQ_D)\sigma_{LM}) \quad (3.19)$$

And operating similarly to *b*, we obtain the following expression:

$$b = \frac{1}{2}\frac{\alpha_L}{\beta_L} + \frac{1}{2}\frac{Exp(Q_L)}{Q_L} + \frac{1}{2}k - \frac{1}{4}\frac{U''(\bar{W}_B)}{U'(\bar{W}_B)}\Big((Q_L + 2L_0)\sigma_L^2 + (Q_L - 2M_0)\sigma_M^2 + 2(M_0 - L_0 - Q_L)\sigma_{LM}\Big) \quad (3.20)$$

Therefore, from the above two equations, the optimal interest margin "*s*" will be:

$$s = a + b = \frac{1}{2}\left(\frac{\alpha_D}{\beta_D} + \frac{\alpha_L}{\beta_L}\right) + \frac{1}{2}\left(\frac{Exp(Q_L)}{Q_L} + \frac{Exp(Q_D)}{Q_D}\right) + \frac{1}{2}d + \frac{1}{2}k - \frac{1}{4}\frac{U''(\bar{W}_B)}{U'(\bar{W}_B)}\Big((Q_L + dQ_D + 2L_0(1-d))\,\sigma_L^2 + (Q_L + Q_D)\,\sigma_M^2 + 2(M_0(1-d) - dQ_D - Q_L)\,\sigma_{LM}\Big) \quad (3.21)$$

where the ratio (α/β) approximates the benefits of market power in terms of higher ratio, greater market power; $-(U''(\bar{W}_B)/U'(\bar{W}_B))$ is the expression of the coefficient of absolute risk aversion; Q is the size of transactions; the ratio $(Exp(Q)/Q)$ is the average cost of transactions (loans or deposits) and the greater this ratio, the greater the margin; σ_M^2 and σ_L^2 are the volatility of the money market interest rate and credit risk, respectively, where σ_{LM} is the interaction between the two risks. Expression (21) is the one commonly used in the Ho and

Saunders (1981) family of models. However, the inclusion of the deposit insurance premium and the capital requirements in the model implies that these two elements appear as determinants of the spread.

First, the higher the capital requirement, the higher the margin. This implies that banks transfer these additional costs to their customers in the form of higher margins. Higher capital requirements tend to erode bank profitability[7], and therefore banks' wealth, since higher capital is more expensive than debt, and it also entails a loss in utility resulting from the reduction in available wealth. Consequently, banks will charge higher margins to compensate for this cost of maintaining the required high levels of capital. In addition, higher levels of capital make the bank more solvent, allowing it to capture deposits at a lower price, which can be translated into higher margins. In light of this effect, in the empirical analysis we test this positive effect of minimum capital requirement on the bank interest margin[8].

Equation (3.21) also shows that effect of the deposit insurance depends on two factors: the direct effect of the cost of the deposit insurance $\left(\frac{1}{2}d\right)$, and its interaction with the credit risk and with the relationship between credit risk and interest rate risk $\left(-\frac{1}{4}\frac{U''(\overline{W}_B)}{U'(\overline{W}_B)}\left((Q_D-2L_0)d\,\sigma_L^2-2(M_0+Q_D)d\sigma_{LM}\right)\right)$. The direct

[7] In fact, the Return on Equity (ROE) gives us information about profitability, measuring the ratio between the result of the entity and its capital and reserves. If banks must devote a lot of resources to capitalize themselves, this ratio is reduced.

[8] Some papers argue that higher levels of capital reduce the risk of the bank and therefore reduce the cost of funding. Unfortunately, this model does not allow us to include this hypothesis as it is assumed that the interest rates in the money market is independent of bank risk and they depend on deposits only, not on the bank's risk portfolio.

effect means that an increase in the cost of the deposit insurance (premium) implies that the bank cannot invest part of the deposits in profitable assets. Therefore, the bank will set larger margins to compensate for this higher opportunity cost. However, the second effect associated to the interaction of the deposit insurance premium with credit risk and with the covariance of credit and interest rate risk is not defined as it depends on other variables. On the one hand, with the deposit insurance the risk assumed by depositors is lower and, consequently, the interest rate of deposits will also be lower. This causes the net interest margin to rise, so the effect of the variable would be positive. On the other hand, the deposit insurance provides banks with an incentive to adopt riskier lending strategies to compensate for the pay-out from the deposit insurance (moral hazard). Some studies in the previous literature find that when banks adopt riskier lending strategies, bank creditors may demand higher interest rates. This is translated into lower net interest margins and, therefore, the expected sign of the deposit insurance variable would be negative. Other studies find that a positive relationship between taking more risk and banks' margins may be due to the greater profitability that banks obtain from their investments by following riskier strategies.

In sum, the effect of the deposit insurance premium on the margins may be positive or negative, depending on which of the two hypotheses described above predominates. The magnitude of the effect must be settled empirically.

3.4. Data, Variables and Methodology

3.4.1. Data

This study analyzes a panel dataset comprising 31 OECD countries[9] over the period 2000-2014. Our main data source for the bank-specific characteristics is the *Bureau Van Dijk's BankScope* database, which provides annual financial information for banks in many countries around the world. We use consolidated financial statements, or unconsolidated ones if these are not available. We consider that the consolidated financial statements are best suited for our purposes since the capital requirement is defined at group level. The macroeconomic data is from the World Development Indicators database (the World Bank); the bank regulation data comes from the Barth *et al.*'s (2013) database, and money market interest rates were obtained from the OECD. The panel data used has 70,328 observations. Table 3.1 provides the number of observations by country and year.

3.4.2. Variables

Dependent variable: net interest margin

The net interest margin (NIM) per unit of assets is used to proxy the dependent variable. This variable is defined as the difference

[9] Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

Table 3.1. Number of observations by country and year.

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Australia	20	16	6	4	9	25	35	31
Austria	151	157	142	180	200	210	212	221
Belgium	51	43	29	25	22	32	31	25
Canada	40	36	34	40	43	52	54	20
Switzerland	251	278	312	338	357	356	345	345
Czech Republic	12	16	11	9	13	14	11	12
Germany	1,746	1,622	1,510	1,395	1,351	1,452	1,491	1,498
Denmark	78	79	75	68	46	53	54	55
Spain	102	111	112	102	97	102	104	97
Finland	7	6	7	1	3	6	7	8
France	249	239	225	215	144	199	201	202
United Kingdom	145	137	137	140	129	116	118	119
Greece	13	10	11	13	13	18	17	14
Hungary	10	11	11	12	14	16	18	14
Ireland	13	11	14	14	11	10	11	11
Israel	14	14	10	10	10	9	9	9
Italy	635	627	617	26	26	599	616	613
Japan	463	394	364	416	394	384	425	401
Korea	10	15	15	16	18	5	5	3
Luxembourg	80	65	39	42	44	43	43	39
Latvia	11	16	9	11	14	19	17	17
Netherlands	31	28	28	15	14	20	19	20
Norway	36	39	21	32	46	96	115	116
New Zealand	6	5	1	1		4	9	10
Poland	32	26	5	6	21	24	22	22
Portugal	32	27	30	27	9	22	26	31
Sweden		91	93	81	79	84	84	83
Slovenia	13	12	14	16	12	13	14	16
Slovak Republic	5	8	11	11	11	11	12	14
Turkey			21	23	14	19	26	28
United States	1,117	1,084	1,129	1,065	722	766	724	698
	5,373	**5,223**	**5,043**	**4,354**	**3,886**	**4,779**	**4,875**	**4,792**

Table 3.1. Number of observations by country and year. *(cont.)*

	2008	2009	2010	2011	2012	2013	2014	Total
Australia	32	34	33	31	33	34	7	350
Austria	200	205	191	197	191	175	161	2,793
Belgium	19	25	30	26	20	27	25	430
Canada	16	17	32	54	60	58	57	613
Switzerland	334	330	316	322	323	324	324	4,855
Czech Republic	13	13	12	12	15	16	15	194
Germany	1,471	1,522	1,565	1,337	1,514	1,487	1,503	22,464
Denmark	48	61	63	59	60	60	61	920
Spain	109	115	103	97	74	91	89	1,505
Finland	8	10	11	14	23	35	28	174
France	191	171	191	191	188	191	176	2,973
United Kingdom	117	113	133	129	132	131	109	1,905
Greece	12	13	13	5	2	5	6	165
Hungary	15	16	18	13	10	13	13	204
Ireland	8	6	4	6	4	5	5	133
Israel	9	9	6	8	8	9	8	142
Italy	605	535	511	498	497	483	465	7,353
Japan	341	420	424	422	431	434		5,713
Korea	3	5	17	19	24	32	28	215
Luxembourg	37	37	36	35	29	33	26	628
Latvia	14	7	10	9	9	10	12	185
Netherlands	23	22	25	23	23	21	19	331
Norway	108	121	111	115	114	120	119	1,309
New Zealand	11	15	15	16	17	18	6	134
Poland	28	22	24	24	23	24	24	327
Portugal	27	28	26	78	95	96	94	648
Sweden	73	77	70	74	77	78	74	1,118
Slovenia	16	15	15	17	16	8	13	210
Slovak Republic	14	16	13	13	13	13	13	178
Turkey	27	27	29	30	30	35	33	342
United States	622	629	656	668	664	653	620	11,817
	4,551	**4,636**	**4,703**	**4,542**	**4,719**	**4,719**	**4,133**	**70,328**

Source: BankScope and authors' calculation.

between interest revenue and financial expenses in relation to total assets. The net interest margin includes the income and expenses of all outstanding loans and deposits. This implies that it is an average indicator of the net interest margin of the new operations and the loans/deposits granted/received in previous years. However, the theoretical model considers the spread between loans and deposits of the bank's new operations. Therefore, the proxy for the dependent variable includes inertia derived from the past that should bias the estimated coefficients. Consequently, we include as an independent variable the lagged dependent variable, i.e. the lagged net interest margin.

Additionally, we include the following independent variables:

Market power (α / β)

To proxy the market power, we use the Lerner index (*Lerner index*) as an indicator of the degree of competition in banking markets. The Lerner index measures the ability of firms to set a price (P), which is above the marginal cost (MC), and is defined as the relative margin of price and marginal cost:

$$Lerner\ index_t = \frac{P_t - MC_t}{P_t} \tag{3.22}$$

The Lerner index ranges from zero to one, where the market power is greater, the higher the index. To calculate the Lerner index, we use the approaches by Berg and Kim (1994), Maudos and Fernández de Guevara (2004), Maudos and Solís (2009) and Fernández de Guevara and Maudos (2017), among others, where the

price of banking output (approximated by total assets) is measured as the ratio between total income and total assets. The marginal cost of banking output is calculated based on a translog cost function which includes total output and three input prices (deposits, labor and capital)[10]. The expected sign of the Lerner index is positive, as the greater the market power, institutions may be allowed to set higher margins.

To test the robustness, we also use the Lerner index corrected by credit risk. Thus, we re-estimate the cost function including, in addition to the financial and operating costs, the provisions that a bank makes each year, a variable that is an ex-post approximation of the cost of risk[11]. Given that the risk cost is included in the dependent variable, the unit cost of that productive input must be included as a determinant, which we can call "risk", approximating it as the ratio between financial asset impairment losses and the volume of lending. The Lerner index corrected for risk was also used by Jiménez *et al.* (2013), who construct it following the approach of Martín-Oliver, *et al.* (2006), using information on the probability of default; and by Cruz-García *et al*. (2018).

[10] The definition of the variables included in the cost function is the same as in Cruz-García *et al.* (2017).

[11] The proxy used for the cost of the risk is conditioned by the public information available. The lag in the setting aside of provisions makes this measurement imperfect in year t. The imperfection is even greater if there are extraordinary provisions due to regulatory measures that affect the recognition of risk.

Average size of operations (Q)

The volume of credit investment is used as a proxy of the average size of operations. This variable is measured by the logarithm of total loans (*Loan*) in the balance of the entities, following the approach of Maudos and Fernández de Guevara (2004). The expected sign of this variable is positive, as the spread is greater for entities that have a larger volume of loans, since this implies greater exposure to credit and interest rate risks. To test the robustness, we also use the logarithm of total assets (*Size*).

Risk aversion $(-(U''(\overline{W}_B)/U'(\overline{W}_B)))$

Following the approach of McShane and Sharpe (1985), Maudos and Fernández de Guevara (2004), Maudos and Solís (2009), Nguyen (2012) and Amuakwa-Mensah and Marbuah (2015), among others, the degree of risk aversion (*Risk Aversion*) is proxied by the ratio between total equity and total assets. According to the theoretical model, the expected sign of this variable is positive as more risk-averse firms will set higher margins. However, this ratio is a measure of capitalization and presents limitations as a measure of risk aversion because of the regulation on minimum capital but, unfortunately, there is no better proxy of this variable.

Average operating costs $(Exp(Q)/Q)$

The average operating costs (*Average cost*) are defined as the ratio of total operating costs to total assets. The expected sign is positive, since the interest margin should cover, at a minimum, the

operating costs and, therefore, the greater average cost, the higher the margin.

Interest rate risk (σ_C^2)

Following usual practice in the empirical specifications of the Ho and Saunders (1981) models (Saunders and Schumacher, 2000; Maudos and Fernández de Guevara, 2004; Doliente, 2005; Cruz-García *et al*., 2019; among others), the volatility of a representative interest rate is used as a proxy of the uncertainty in the money market, Specifically, the three-month inter-bank interest rate (*Interest rate risk*) is used. To proxy this variable, we use the standard deviation of this interest rate, calculated with monthly data. The expected sign of this variable is positive since the higher the volatility, the greater risk assumed and, therefore, a higher interest margin to compensate for this risk.

Credit risk (σ_L^2)

The model predicts that the higher probability of credit default obliges banks to set greater interest margins, requesting an implicit risk premium. Unfortunately, the information on delinquency loans in BankScope is incomplete, so we use the ratio of provisions for insolvencies to the volume of credit granted (*Credit risk*) to proxy the ex-post credit risk, as the higher the default rate, the larger the provisions. Accordingly, the expected sign of this variable is positive.

Interaction between interest rate risk and credit risk (σ_{CL}^2)

The product between *Interest rate risk* and *Credit risk* is used as a measure of the interaction between credit risk and market risk. The theoretical model shows that the expected sign of these variables is positive.

Capital requirements (k)

According to our model, the proxy of the capital requirements (*Capital stringency*) should be the percentage of minimum capital requirement. However, during the period considered this percentage was 8% in 99% of the observations in the sample. Given the low variability in this variable, we use the Capital Regulatory Index from Barth *et al.* (2013). This indicator not only measures the level of the requirement, but also its stringency in terms of the definition of both capital and risk weight assets. In fact, the index is composed of the aggregation of two components: Overall Capital Stringency, which measures whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined; and Initial Capital Stringency, which measures whether certain funds may be used to initially capitalize a bank and whether they are official. This index is built from four surveys sponsored by the World Bank, performed in 1999, 2003, 2007 and 2011. As the surveys are not available annually we use the value of the indexes from the first survey (published in 2001) for the year 2000, the value of the variables from the second survey (published in 2003) for the period 2001 to 2002, the value of the variables from the third survey (published in 2007) for the period

2003 to 2006, and the value of the variables from the last survey (published in 2012) for the period 2007 to 2014. In the latter case, we also use the last survey for the years 2012-2014, as unfortunately no new survey is available, and considering that the main changes in Basel III were not implemented before 2014. The Capital Regulatory Index includes answers from 10 questions, ranged in the interval 1-10[12], where higher values indicate greater stringency. According to the theoretical model, a positive relationship between this variable and the interest margin is expected, as the cost of maintaining the required high levels of bank capital is more expensive than the debt.

Deposit requirements (d)

The theoretical model also includes the deposit insurance premium as a determinant of the interest rate margin. Again, this information is not available so it could not be included in the empirical analysis. However, given that the theoretical model shows that the effect of deposit insurance depends on the credit risk and on the interaction between credit risk and interest rate risk, we use a proxy (*Deposit insurance*) that indicates if the deposit insurance scheme depends on the bank risk portfolio. Moreover, as mentioned in the previous section, Merton (1977) proposed that the actuarial price of the deposit insurance premium depends on the proportion of assets and deposits and the volatility of the bank's assets. In this context, to capture the effect of changes in deposit requirements, we use a dummy variable from Barth *et al.*'s (2013) database. This variable

[12] In the last survey, the number of questions was reduced to 8, multiplying the value of the answer of question 4 by three. The index, therefore, still ranges between 0 and 10.

takes the value one if the deposit insurance rates charged to banks vary based on a risk assessment, and zero otherwise. We assume deposit insurance schemes based on the bank's risk profile will be more demanding than deposit insurance schemes that are not. As already described, the expected sign of this variable is ambiguous and it depends on which effect predominates.

The result obtained by the theoretical model gives us an approximation of a "pure" interest margin. However, many other variables are potential determinants of the intermediation margin, which are difficult to incorporate into the theoretical models. Specifically, the previous literature considers the following variables related to characteristics specific to banks.

Liquidity reserves

The ratio between liquid reserves[13] and total assets is used as a proxy for liquid reserves (*Reserves*). A higher volume of liquid reserves means that the bank cannot invest these funds in more profitable assets; that is, it will imply a higher opportunity cost, so the expected sign of this variable is positive.

Implicit interest payments

Banks often remunerate their deposits not only with the interest rate they pay, but also with other services associated to the deposits. These services usually involve implicit rather than explicit remuneration. Following Ho and Saunders (1981), Angbazo (1997),

[13] The liquid reserves of the entity are measured by the "cash and bank deposits" variable in the BankScope database.

Saunders and Schumacher (2000) and Maudos and Fernández de Guevara (2004), among others, the implicit interest payments (*Implicit payments*) are proxied by the ratio of operating expenses net of non-interest revenues, as a percentage of total assets. The expected sign of this variable is positive.

Management efficiency

The quality of management (*Efficiency*) involves selecting the most profitable assets and the deposits with the lowest cost. An approximation of this variable is the ratio of operating expenses to operating income. Therefore, a higher value of this ratio means a lower operating efficiency. Hence, the expected sign of this variable is negative.

GDP growth

Considering the heterogeneity of the sample and in order to control for the possible influence of the economic cycle on interest margins, we have included the annual rate of GDP growth (*GDP growth*).

Table 3.2 provides an overview of the variables included in the analysis and their expected impact on the net interest margin. Table 3.3 provides summary statistics for the sample.

Table 3.2. Variable description.

Variable	Proxy	Expected Sign
Model-derived variables		
Net interest margin	(Financial revenue-financial expenses)/total assets	
Market power	Lerner index: $(P_i\text{-}MC_i)/P_i$, where total market power is calculated using total assets as an output with a three/four factor translog cost function	+
Average size of operations	Logarithm of total loans	+
	Logarithm of total assets	+
Degree of risk aversion	Equity/total assets	+
Average operating costs	Total operating costs/total assets	+
Interest rate risk	Standard deviation of the three-month inter-bank interest rate.	+
Credit risk	Provisions for insolvencies/volume of credit granted	+
Interaction between interest rate risk and credit risk	Product between the variables that approximate interest rate risk and credit risk.	+
Capital requirements	Capital Regulatory Index from Barth, Caprio and Levine (2013).	+
Deposit requirements	Dummy variable, which takes the value one if the deposit insurance rates vary based on some assessment of risk; and zero otherwise.	?
Other variables		
Implicit interest payments	(Operating expenses-non-interest income)/total assets	+
Management efficiency	Operating expenses/operating income	-
Liquidity reserves	Liquid reserves (cash and bank deposits)/total assets	+
GDP growth	Annual growth rate of GDP	+

Table 3.3. Descriptive statistics.

	Mean	Std. Dev.	Median	Percentile 25%	Percentile 75%	Number of obs.
Net interest margin (%)	2.42	1.04	2.38	1.78	2.91	70,328
Lerner index	0.23	0.10	0.22	0.16	0.29	70,328
Risk-corrected Lerner index	0.17	0.13	0.17	0.10	0.25	61,100
Log (loans)	13.26	1.90	13.02	12.00	14.29	70,328
Log (total assets)	13.82	1.88	13.55	12.53	14.84	70,328
Risk aversion (%)	8.39	5.20	7.44	5.38	10.04	70,328
Average costs (%)	2.31	1.26	2.19	1.56	2.75	70,328
Interest rate risk	0.29	0.25	0.21	0.10	0.46	69,104
Credit risk (provisions/loans) (%)	0.62	0.83	0.42	0.13	0.87	70,328
Risk covariance	0.0019	0.0039	0.0007	0.0001	0.0024	69,104
Capital stringency (0-10)	6.53	1.31	7.00	5.50	7.50	66,156
Deposit requirements (% of banks whose deposit insurance rate varies according to the risk assumed)	63.53	-	-	-	-	64,516
Reserves (%)	2.38	3.55	1.67	0.88	2.56	69,814
Implicit payments (%)	1.28	0.86	1.32	0.89	1.69	70,328
Efficiency	67.00	13.10	67.47	59.15	75.21	70,328
GDP growth (%)	1.57	2.47	1.71	0.41	2.96	69,961

Source: BankScope; OECD; The World Bank; Barth *et al.* (2013) and authors' calculation.

3.4.3. Methodology

The empirical approach consists in regressing the net interest margin (as a percentage of total assets) against the determinants described in the previous section. The net interest margin in bank financial accounts includes the margin of both new business (loans and deposits) and outstanding amounts. Therefore, it does not fully correspond with the interest rate spread of the theoretical model, which refers only to new business. Thus, we include the dependent

variable lagged by a period as explanatory variable to capture the inertia effects of the outstanding amounts in the net interest margin. The empirical estimation adopts the two-step system GMM dynamic panel estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The possible endogeneity problems stem from the inclusion of the lagged dependent variable as an explanatory variable. We avoid this problem by estimating the model using the lagged variables on levels as instruments.

The consistency of the GMM estimator depends both on the assumption that the error term has no serial correlation and on the validity of the instruments used. To assess the first assumption, we test whether the differential error term is correlated in second-order series. By construction, the error term will have first-order serial correlation. To assess the second assumption, we use the Hansen test of over-identifying restrictions, which tests the overall validity of the instruments.

The estimation also includes time effects to reflect the impact of particular shocks in each year affecting the dependent variable. The inclusion of time dummies is particularly relevant for a period of analysis such as the one in this chapter, which comprises some years previous to the crisis, and the financial crisis that began in 2008.

Taking all the above into account, the following equation models the net interest margin of a bank i in year t:

$$
\begin{aligned}
NIM_{it} = {} & \beta_0 + \beta_1 NIM_{it-1} + \beta_2\, Implicit\ interest\ payments_{it} \\
& + \beta_3 Efficiency_{it} + \beta_4 Lerner\ index \\
& + \beta_5 Interest\ rate\ risk_{it} + \beta_6\, Credit\ risk_{it} \\
& + \beta_7\, Risk\ covariance_{it} + \beta_8 Loan_{it} + \beta_9 Risk\ aversion_{it} \\
& + \beta_{10} Average\ cost_{it} + \beta_{11} Reserves_{it} \\
& + \beta_{12} Capital\ stringency_{it} \\
& + \beta_{13} Deposit\ insurance_{it} + \beta_{14} GDP\ growth_{it} + \varepsilon_i + \alpha_t \\
& + u_{it}
\end{aligned}
\tag{3.22}
$$

where ε_i are individual effects and α_t are time effects.

3.5. Results

3.5.1. Determinants of net interest margins

This section contains the results for the two-step system GMM dynamic estimation of the model. Before discussing the results obtained from this estimation, it is interesting to examine the evolution of the dependent variable.

Figure 3.1 shows that the level and the evolution of the net interest margin (expressed as a percentage of total assets) vary notably across the countries/geographical areas in the sample. Japan and United Kingdom have comparatively lower levels of net interest margin, followed by the euro area, whereas the United States enjoys the highest margins. The net interest margin declines sharply in Japan, United Kingdom and the group of other countries in the sample; this decline is less harsh in the euro area and the United States.

Figure 3.1. Net interest income (% total assets).

Source: BankScope.

Table 3.4 reports the results of estimating the equation of the determinants of the net interest margin. All the estimations reported in Table 3.4 satisfy the statistical test that rejects the second-order serial correlation, as well as the Hansen test for over-identifying restrictions. Furthermore, all estimations include bank fixed effects and time effects. To correct the possible endogeneity problems that may arise from the inclusion of the lagged dependent variable as an explanatory variable, NIM and the other endogenous variables (risk aversion, the average size of operations, liquid reserves and the operating costs) are instrumented with their third differences. In the case of the Lerner index, endogeneity issues may be driven by the fact that it is defined as a margin between net interest margin and marginal costs. Therefore, the Lerner index is instrumented with the Herfindahl-

Table 3.4. Determinants of net interest income per unit of asset. 2000-2014.

Dependent variable: Net interest margin$_{it}$/Total Assets$_{it}$								
	[1]		**[2]**		**[3]**		**[4]**	
Net interest margin$_{i(t-1)}$	0.0981	**	0.0850	**	0.0850	**	0.0481	
	(0.0413)		(0.0425)		(0.0425)		(0.0386)	
Lerner index$_{it}$	0.0146	**	0.0143	**	0.0143	**	0.0190	***
	(0.0059)		(0.0066)		(0.0066)		(0.0063)	
Log (loans)$_{it}$	-0.0001		-0.0002	*	-0.0002	*	-0.0003	**
	(0.0001)		(0.0001)		(0.0001)		(0.0001)	
Risk aversion$_{it}$	-0.0012		0.0093		0.0093		0.0072	
	(0.0061)		(0.0090)		(0.0090)		(0.0086)	
Average costs$_{it}$	0.3228	***	0.3020	***	0.3020	***	0.2702	***
	(0.0620)		(0.0541)		(0.0541)		(0.0518)	
Interest rate risk$_{it}$	-0.0282		0.0578		0.0578		-0.0593	
	(0.1444)		(0.1272)		(0.1272)		(0.1507)	
Credit risk (provisions/total assets)$_{it}$	0.0362		0.0377		0.0377		0.1323	**
	(0.0388)		(0.0325)		(0.0325)		(0.0514)	
Risk covariance$_{it}$	-0.0962		-0.0108		-0.0108		0.0974	
	(0.1014)		(0.0993)		(0.0993)		(0.1185)	
Capital stringency$_{it}$			0.0004	**	0.0004	**	0.0002	*
			(0.0002)		(0.0002)		(0.0001)	
Deposit insurance$_{it}$			0.0012	***	0.0012	***	0.0023	***
			(0.0003)		(0.0003)		(0.0006)	
Credit risk$_{it}$ x Deposit insurance$_{it}$							-0.1800	***
							(0.0648)	

Hirschman index (HHI), a measure of market concentration calculated by the sum of the squared market shares (proxied by total assets) of each bank.

The first column shows the results obtained for the baseline model. The implicit payments, efficiency, the Lerner index of market power and the average costs have a statistically significant coefficient with the expected signs in consonance with the predictions of the theoretical model. This result implies that banks with more market power set higher interest margins, and that banks bearing higher operating expenses also need to set higher margins to cover them.

Table 3.4. Determinants of net interest income per unit of asset. 2000-2014. *(cont.)*

Dependent variable: Net interest margin$_{it}$/Total Assets$_{it}$								
	[1]		**[2]**		**[3]**		**[4]**	
Reserves$_{it}$	-0.0099	*	-0.0119	*	-0.0119	*	-0.0151	**
	(0.0053)		(0.0068)		(0.0068)		(0.0065)	
Implicit payments$_{it}$	0.9535	***	0.8488	***	0.8488	***	0.9188	***
	(0.0423)		(0.0572)		(0.0572)		(0.0515)	
Efficiency$_{it}$	-0.0426	***	-0.0382	***	-0.0382	***	-0.0399	***
	(0.0047)		(0.0048)		(0.0048)		(0.0043)	
GDP growth$_{it}$	0.0110		0.0061		0.0061		0.0147	
	(0.0076)		(0.0086)		(0.0086)		(0.0092)	
Crisis dummy					-0.0352	***		
					(0.0091)			
Constant	0.0566	***	0.0249	***	0.0594	***	0.0279	***
	(0.0110)		(0.0045)		(0.0113)		(0.0043)	
Number of observations	56,533		52,617		52,617		52,617	
Arellano-Bond test for AR(1) in first differences [p-value]	-2.71 [0.007]		-3.70 [0.000]		-3.70 [0.000]		-3.23 [0.001]	
Arellano-Bond test for AR(2) in first differences [p-value]	1.01 [0.310]		1.06 [0.290]		1.06 [0.290]		1.34 [0.181]	
Hansen test of overid. restrictions [p-value]	41.45 [0.080]		46.94 [0.127]		46.94 [0.086]		48.44 [0.119]	

* p<0.10, ** p<0.05, *** p<0.01.

Note: Variables are in parts per unit. It should be noted that, due to the use of lagged variables as instruments, considerably fewer observations are shown in the estimates table than reflected in the table of descriptive statistics.

Better managed banks enjoy larger margins, given the negative impact of the variable, which is inversely proportional to management efficiency. Higher implicit payments translate into a greater margin. Finally, the lagged dependent variable shows a positive and significant coefficient, which confirms the high inertia in the determinants of the NIM.

In the second column, we introduce the variables whose analysis is the objective of this chapter: the deposit insurance and the capital

requirement. In this case the implicit payments, management quality, market power and average operating costs also have a statistically significant effect and the expected sign. Interestingly, the deposit insurance and the capital requirement have a statistically significant effect too, which supports the importance of our extension of the theoretical model. On the one hand, higher capital requirements imply that banks translate this additional cost of funding to their net interest margin. This result is in line with those obtained by Kannan *et al.* (2001), among others. On the other hand, the deposit insurance variable is positively related to the net interest margin. This implies that banks operating in countries in which the contribution to the deposit insurance depends on banks' risk—which we assume will be more demanding—will have higher net interest margins. Specifically, the difference in the net interest margin of a bank in a country with a risk-dependent scheme for the deposit insurance is 0.12 percentage points (pp) higher than in a bank with the same characteristics except that it operates in a country with a deposit insurance scheme that does not depend on risk. In sum, we once again observe that banks pass on part of the additional costs derived from the regulation to their customers.

In the third column, a dummy is included for the years of the financial crisis (2008-2014), remaining the results essentially the same as the previous column. The crisis variable has a significant coefficient and the expected negative sign, considering the negative effect of the crisis on bank net interest margins which can also be observed in Figure 3.1.

Column four incorporates the interaction term between credit risk and the deposit insurance to assess a possible effect of the deposit

insurance scheme on the risk assumed by banks. In this case the implicit payments, efficiency, market power, credit risk, average operating costs and capital stringency have statistically significant coefficients with the expected signs. The deposit requirements variable shows a positive and statistically significant coefficient. The interaction between credit risk and the deposit insurance shows a negative, statistically significant coefficient. This implies that the effect of credit risk on the net interest margin is lower when the deposit insurance premium depends on that risk.

Some additional tests for robustness were performed and are detailed in Table 3.5. First, we used the Lerner index corrected by credit risk as an alternative proxy of market power (first column). Second, the size of banking transactions was proxied by the logarithm of total assets (second column). Third, we removed from the sample the countries that belong to the euro area since they share a similar capital deposit insurance regulatory framework. This final sample has 25,490 observations. The results hold in all these cases, suggesting that they are robust to these different specifications.

3.5.2. Economic impact

To quantify the economic impact of each variable we consider the change, in basis points (bp), in the net interest margin associated with an interquartile variation of each of these explanatory variables, i.e. a change from percentile 25 to 75 of the distribution. Taking the estimated parameters in column 2 of Table 3.4, Figure 3.2 ranks the variables from the largest to the smallest impact, showing that the variable implicit payments has the greatest effect. In particular,

Table 3.5. Robustness tests: alternative measures for some variables and alternative samples.

Dependent variable: Net interest margin$_{it}$/Total Assets$_{it}$								
	[1]			**[2]**			**[3]**	
Net interest margin$_{i(t-1)}$	0.1003	***		0.0844	**		0.2665	***
	(0.0366)			(0.0423)			(0.0821)	
Lerner index$_{it}$				0.0146	**		0.0210	***
				(0.0065)			(0.0051)	
Risk-corrected Lerner index$_{it}$	0.0199	***						
	(0.0061)							
Log (loans)$_{it}$	-0.0001						-0.0001	
	(0.0001)						(0.0002)	
Log (total assets)$_{it}$				-0.0002	*			
				(0.0001)				
Risk aversion$_{it}$	0.0040			0.0092			-0.0024	
	(0.0079)			(0.0089)			(0.0045)	
Average costs$_{it}$	0.2544	***		0.3024	***		0.2017	***
	(0.0583)			(0.0540)			(0.0505)	
Interest rate risk$_{it}$	-0.0353			0.0537			-0.0137	
	(0.1220)			(0.1279)			(0.1785)	
Credit risk (provisions/total assets)$_{it}$	0.2497	***		0.0377			0.1432	***
	(0.0754)			(0.0326)			(0.0386)	
Risk covariance$_{it}$	-0.0487			-0.0108			-0.1831	**
	(0.1040)			(0.0990)			(0.0924)	
Capital stringency$_{it}$	0.0002	*		0.0004	**		-0.0001	
	(0.0001)			(0.0002)			(0.0002)	

moving from percentile 25 to 75 of the distribution has an impact of 69 bp on the net interest margin. The variable efficiency has the second largest economic impact on the dependent variable, with a change of 61 bp. Average cost is the variable with the third largest impact of 36 bp. Market power is the fourth most important variable, with an impact of 18 bp. The two regulatory variables included in the chapter are also relevant but to a lesser extent than the above-mentioned variables. For example, if the bank in a country situated in

Table 3.5. Robustness tests: alternative measures for some variables and alternative samples. *(cont.)*

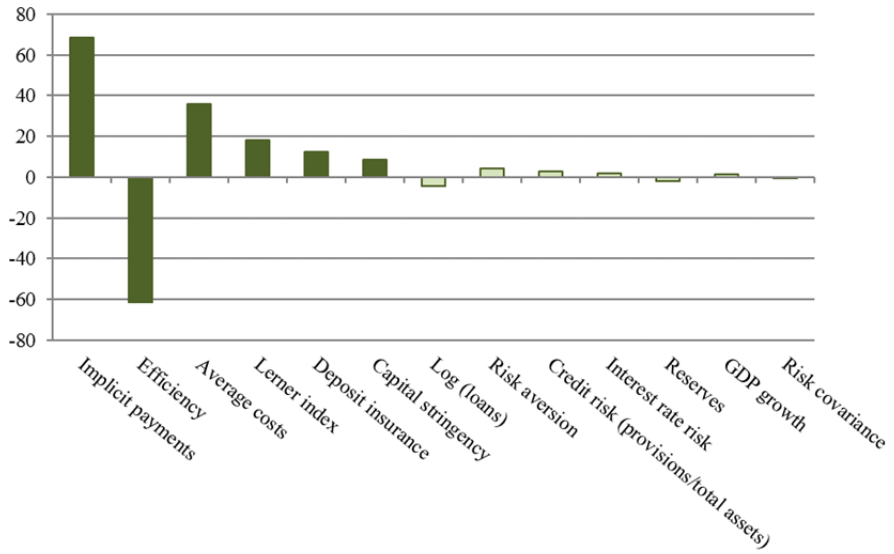
Dependent variable: Net interest margin$_{it}$/Total Assets$_{it}$			
	[1]	**[2]**	**[3]**
Deposit insurance$_{it}$	0.0009 ***	0.0013 ***	0.0027 ***
	(0.0003)	(0.0003)	(0.0006)
Reserves$_{it}$	-0.0197 **	-0.0118 *	-0.0168 ***
	(0.0077)	(0.0067)	(0.0053)
Implicit payments$_{it}$	0.8843 ***	0.8403 ***	0.6176 ***
	(0.0512)	(0.0584)	(0.0874)
Efficiency$_{it}$	-0.0369 ***	-0.0377 ***	-0.0240 ***
	(0.0045)	(0.0048)	(0.0056)
GDP growth$_{it}$	-0.0011	0.0059	0.0454 **
	(0.0082)	(0.0086)	(0.0230)
Constant	0.0521 ***	0.0248 ***	0.0174 ***
	(0.0113)	(0.0045)	(0.0055)
Number of observations	45.671	52.617	17.162
Arellano-Bond test for AR(1) in first differences [p-value]	-3.68 [0.000]	-2.76 [0.006]	-3.00 [0.003]
Arellano-Bond test for AR(2) in first differences [p-value]	1.09 [0.276]	0.74 [0.462]	-1.63 [0.103]
Hansen test of overid. restrictions [p-value]	47.10 [0.124]	42.04 [0.300]	48.39 [0.121]

* p<0.10, ** p<0.05, *** p<0.01.

Note: Variables are in parts per unit. It should be noted that, due to the use of lagged variables as instruments, considerably fewer observations are shown in the estimates table than reflected in the table of descriptive statistics.

percentile 25 of the capital stringency indicators increased the standards to a value equivalent to the bank in percentile 75, the net interest margin would increase by 8.5 bp. That is, instead of an average net interest margin of 2.42% it would be 2.50%, which is an increase of 3% in the margin. This increase in the net interest margin is relevant considering that the process of applying Basel III is currently underway. The regulation has become stricter in this framework, in terms of both the quantity and the quality of capital

Figure 3.2. Economic impact of net interest margin determinants. Basis points.



Note: The figure shows the effect on the net interest margin of a variation in each of the explanatory variables from the value of the bank located in the percentile 25 to 75. The faint colored bars in the figure correspond to variables with no statistically significant effect. The variables are ordered from the highest to lowest relevance.

Source: Authors' calculation.

required, as one of the key factors in this regulatory change is the more rigorous capital requirements. In the case of the deposit insurance, an increase from a non-risk to a risk dependent scheme would lead to an increase of 12 bp in the net interest margin.

3.5.3. Simulation exercise

Having obtained the results of the estimation, we carried out a simple simulation exercise for five large European Union member states (Germany, France, Spain, Italy and the United Kingdom) and the United States. This simulation exercise, whose data can be seen in

Appendix 3.A of this chapter, was based on the results from column 2 of Table 3.4. It calculates the net interest margin per unit of assets for the banks in the countries analyzed, if the questions included in the Capital Stringency indicator were answered under the full implementation of the first pillar of Basel III. According to our results, the increase in the net interest margin derived from the capital increase of Basel III is 0.04 pp in Germany, France, Spain and United States; 0.13 pp in Italy and 0.25 pp in the United Kingdom[14].

3.6. Conclusions

This chapter's analysis of the determinants of bank interest margin for a sample of 31 OECD countries during the period 2000-2014 contributes to the literature in several ways. Firstly, starting from the model of Ho and Saunders (1981) and subsequent extensions, we extended the theoretical model to include two important aspects of banking regulation: i) capital requirements and ii) deposit insurance requirements. This extension of the theoretical model shows that the net interest margin depends on the usual indicators in the Ho and Saunders (1981) model (market power, interest risk, credit risk, interaction between risks, banks' risk aversion, liquid reserves, and operating expenses) but also on capital requirements and the deposit insurance premium. Higher capital requirements are associated with higher interest spreads. The minimum capital requirement implies a

[14] It would be interesting to perform the same analysis for Japan. However, the lack of data in the latest available survey has prevented us from doing so.

loss in utility due to the reduction of available wealth. Moreover, maintaining higher capital requirements is more expensive than debt, as it tends to erode profitability and therefore the bank's wealth. In consequence, banks will charge higher margins to compensate for this cost of maintaining the required high levels of capital. In addition, banks can capture deposits at a lower price since they are more solvent, which also translates into a greater margin. However, the deposit insurance premium can have a positive or a negative influence. This depends on which is the predominant effect: the direct effect or the effect associated to the interaction of the deposit insurance premium with credit risk and with the covariance of credit and interest rate risk. The first effect implies that an increase in the deposit insurance premium means the bank cannot invest part of the deposits in profitable assets. In this case, the bank will set higher margins to compensate for this opportunity cost, so the effect of this variable on the margin is positive. The second effect can be positive or negative. On the one hand, with the existence of deposit insurance the risk assumed by depositors is lower and they will demand a lower interest rate for their deposits, so that the effect of this variable on the margin is positive. On the other hand, deposit insurance can cause moral hazard problems, encouraging banks to adopt riskier –and more profitable– lending strategies to compensate for the pay-out from this deposit insurance. In this case, depositors may demand higher interest rates, negatively affecting the margin, so the effect of this variable is negative.

The results obtained from the theoretical model are empirically contrasted for a panel of 70,328 observations of 31 OECD countries in the period 2000-2014. We empirically confirm the positive

relationship between net interest margin and both the capital stringency and the deposit insurance requirements. Higher capital stringency leads to higher interest margin. In the case of the deposit insurance requirements, the positive sign may be explained by the fact that depositors are exposed to a lower risk and, therefore, the interest rate on deposits is lower. In consequence, the net interest margin is higher. Regarding the rest of the variables postulated as determinants of the net interest margin, the only ones with a significant effect are the competitive conditions of the market, average operating costs, implicit payments and management efficiency.

It is widely recognized that increased capital requirements have clear benefits for policymakers: more capital reduces the probability of financial distress. The findings described in this chapter suggest that banks transfer, at least partially, the higher capital requirement to a higher net interest margin. In fact, the results of the simulation exercise show that if the questions included in the Capital Stringency indicator were answered under the full implementation of the first pillar of Basel III (with higher capital requirements), the increase in the net interest margin would be 0.04pp in Germany, France, Spain and United States; 0.13pp in Italy and 0.25pp in the United Kingdom. These results imply that the cost of an increase in higher capital stringency is ultimately borne by the final consumers. In the case of deposit regulation, policymakers should carefully monitor the premium and the guarantee to avoid moral hazard problems, otherwise, financial stability could be jeopardized. If depositors are uncertain about the extent and speed with which their losses will be covered in case of a crisis, they have incentives to control the behavior of the bank. In addition, with the deposit insurance (if it is not well

monitored), in the case of crisis, other bank creditors (and perhaps even bank shareholders) may be in a better position to pressurize policymakers to extend protection to their own claims. An exception to this would be countries with a very good institutional environment. According to Demirgüç-Kunt and Detragiache (2002), in these cases deposit insurance may not generate additional instability, perhaps because in those countries regulators can more effectively compensate for moral hazard.

Finally, the increased regulatory standards introduced after the outbreak of the crisis imply greater banking stability, and that banks will probably have incentives to act more prudently. However, there is no free lunch. According to our results, the cost of the increased stability will be transferred to banks' customers in the form of higher interest rates on their loans or reduced interest rates on their deposits.

Appendix 3.A. Data from the latest survey by Barth *et al.* (2013) and predicted data for the simulation

	Questions	Answer in the latest available survey						Predicted answer under the full implementation of the first pillar of Basel III
		Germany	**France**	**Spain**	**Italy**	**UK**	**USA**	
Overall Capital Stringency (Higher values indicate greater stringency) Yes = 1; No = 0	1. Did you use the Basel I as of end of 2010?	No (0)	No (0)	No (0)	No (0)	No (0)	Yes (1)	Yes (1) *as a minimum
	2. Does the minimum ratio vary as a function of an individual bank's credit risk?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
	3. Does the minimum ratio vary as a function of market risk?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
	4. Are the unrealized losses in fair valued exposures deducted from regulatory capital?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	No (1)	Yes (1)
1+2+3+4*3+1 (if 5 < 0.75)	5. What fraction of revaluation gains is allowed as part of capital?	0.45 (1)	0.45 (1)	0.35 (1)	1.00 (0)	– (0)	0.45 (1)	0.60 (1)
Initial Capital Stringency (Higher values indicate greater stringency) For question 1: Yes = 1; No = 0 For questions 2 and 3: Yes = 0; No = 1	1. Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities?	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
	2. Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities?	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
1+2+3	3. Can initial disbursement of capital be done with borrowed funds?	No (1)	No (1)	No (1)	Yes (0)	Yes (0)	Yes (0)	No (1)
	Capital Regulatory Index (Higher values indicate greater stringency) Overall Capital Stringency + Initial Capital Stringency	8	8	8	6	3	8	9

Note: The numbers in brackets after the response given by the Central Bank are the values the authors of the survey assigned to each answer. The last column corresponds to the predicted answer under the full implementation of the first pillar of Basel III. In this context, in the case of United Kingdom for example, under the full implementation of the first pillar of Basel III, its Capital Regulatory Index would rise from 3 to 9. In question 1, most central banks answered "No", since they had already implemented Basel II. However, the authors of the survey consider this response to be a minor capital stringency.

Source: Authors' calculation.

CHAPTER 4

Market Power in the Spanish Banking Sector: The Effect of Multimarket Contact and its Intensity

4. Market Power in the Spanish Banking Sector: The Effect of Multimarket Contact and its Intensity

4.1. Introduction

The outbreak of the financial crisis in 2008 led to modifications in the competitive conditions in the European banking sector. On the one hand, the need for bank restructuring, mainly aimed at reducing the installed capacity, has led to multiple mergers and acquisitions, and consequently, increased market concentration. In fact, in a press release in May 2018 the European Central Bank (ECB) reported that market concentration reached a historical maximum in 2017. In addition, these mergers and acquisitions have modified bank branch networks due to the closure of a notable percentage of branches. On the other hand, progress towards banking union, in an attempt to return to pre-crisis levels of financial integration, has resulted in a playing field that is more open to competition. Moreover, the new technologies are jeopardizing the traditional banking markets due to the emergence of new so-called *fintech* firms operating in some banking segments. These firms increase competition in the financial sector, extending the pool of potential suppliers of financial products

and services. All these changes in the banking market structure have altered factors such as rivalry and competitive pressure among banks.

Since the number of banks has fallen drastically in many European countries due to mergers and acquisitions, the industry is increasingly dominated by large banks. According to the *Banking Structural Financial Indicators* of the ECB, the number of credit institutions in the euro area fell from 6,570 in 2008 to 4,769 in 2017 (-27.41%). The decline in bank numbers for some specific countries of the euro area was 43.09% in Spain, 17.95% in Germany, 33.25% in Italy and 42.03% in France. This has translated in a scaling down of branch network size to reduce overcapacity. In the euro area, the number of bank branches fell from 186,255 in 2008 to 112,844 in 2017 (39.41%), with rates of 40.34%, 18.98%,[15] 19.72% and 5.72%, for Spain, Germany, Italy and France, respectively, in the same period. The evidence in some countries points to the emergence of "national champions" which may dominate the domestic markets. The greater concentration of banking activity in a small group of banks may be detrimental to competition in the long term.[16] As detriment to competition ultimately affects the welfare of consumers, antitrust authorities are working to preserve, guarantee and promote effective competition.

The implication of this reduced number of branches is that the number of geographical markets in which banks coincide has been

[15] Unfortunately, the ECB does not report the number of German bank branches for 2017; the last year for which figures were available was 2016.

[16] Certain antitrust authorities base their decisions on the analysis of the change in concentration following a merger or acquisition. The underlying idea is that the fewer the banks and the larger they are, the easier it is for them to collude.

modified, that is, the number of multimarket contacts. Multimarket contact exists when firms operate at the same time in different geographical markets. The fact that firms are in repeated contact with each other in different markets may affect the way they behave and compete. The main hypothesis in the literature is that multimarket linkages between firms reduce competition (Edwards, 1955), suggesting the existence of collusive behavior between them. That is, firms operating in the same geographical markets may have less incentive to compete in a given market if they fear reprisals from their rivals not only in that market, but in all markets in which they coincide. However, following the seminal paper of Solomon (1970), other studies find a positive effect of multimarket contact on competition, and reject collusive behavior among firms. To date, therefore, results are ambiguous and conclusions are mixed.

A further implication of the restructuring process is not only the change in the number of geographical markets in which banks coincide, but also the intensity of this connection because the number of coinciding bank branches has also changed. Therefore, it is interesting to explore not only whether a bank's average number of contacts has risen or fallen, but also whether the intensity of that contact has also altered. This aspect merits close consideration, especially in cases in which the closure of bank branches in recent years has been very uneven between banks and markets, which could have consequences for competitive rivalry. Consequently, one of the main contributions of our study is the proposal of a new indicator of multimarket contact that considers the intensity of these contacts.

The new indicator measures the number of branches a bank has with respect to the number of its rivals' branches in the markets in

which they coincide (weighting each market based on the weight it has in the bank's branch network). Therefore, this new indicator reflects whether the bank is in a strong or a weak position with respect to its rivals, enabling us to divide the banks into two groups: dominant banks, and weaker or fringe banks.

Since this new indicator measures the dominant- or weak-fringe position of banks in the markets they operate in, it can be used to test the prevalence of one of the predictions in the industrial organization literature regarding the existence of an oligopolistic market structure with dominant firms in the market: Stackelberg *leader-follower* behavior or *dominant-fringe* behavior.

This chapter studies the effect on competition of branch closures resulting from bank restructuring through the number of markets where banks coincide, that is, multimarket contact and the intensity of this contact. This effect is explored in the context of the Spanish banking sector, which is one of the sectors most deeply affected by restructuring due to the imbalances accumulated during the period prior to the crisis, especially in terms of branches and staffing levels (over capacity). In addition, in the Spanish banking sector a few very large banks that compete nationally coexist with many others established in certain regions, so competition occurs mainly at the local level, with potential geographical overlaps. This, together with the availability of data, makes the Spanish banking sector an ideal context for analyzing multimarket contact and its intensity, as well as the banks' relationship with competition.

In this context, the aim of this study is twofold. First, we analyze the evolution of the market power in the Spanish banking sector using the Lerner index corrected for credit risk. Second, we study the factors

that explain banks' market power, focusing on the effect of branch closures resulting from bank restructuring, through multimarket contact and its intensity. For this purpose, we propose a novel indicator of multimarket competition that considers not only the existence of contact among banks in different markets, but also the intensity of the contact.

Our contributions to the literature are the following. To the best of our knowledge, this study is the first, for the Spanish banking case, to include multimarket contact as a determinant of market power. Additionally, our period of analysis (2006–2017) covers a complete cycle in which the number of branches soared in Spain before the crisis, but subsequently plunged once the crisis began. Moreover, the Lerner index corrected for risk as a proxy of market power has been used by only a few authors, namely, Jiménez *et al.* (2013), whose construction follows the approach of Martín-Oliver *et al.* (2006), using information on the probability of default; and Cruz-García *et al*. (2018). In addition, we propose a new indicator of multimarket contact that considers the intensity of multimarket contacts according to the banks' position of dominance/weakness, in terms of branches, with respect to their rivals, and that also allows us to demonstrate the existence of a dominant-fringe equilibrium in the Spanish banking sector. Finally, we use the zip code (11,752 markets) to define the relevant market for branches, instead of municipalities, which are normally used in the literature. Large Spanish municipalities contain more than one area delimited by a zip code.[17]

[17] With the exception of large municipalities, the area delimited by a zip code and the municipality coincide in Spain.

By way of preview, the empirical results obtained suggest that the decline in multimarket contacts among Spanish banks is negatively related to market power, and that this is a non-linear relationship, specifically a U-shaped form. Given that the vast majority of the observations in our sample are located in the decreasing part of the U-shaped function, we can assume a negative relationship between market power and multimarket contacts. Therefore, this result does not support the hypothesis of collusion in the Spanish banking industry, as the higher the contact between banks, the lower the market power will be. However, when the new indicator of multimarket contact that considers the intensity of the contact is used, the opposite image emerges and we find evidence of tacit collusion. That is, if a bank has fewer branches than its rivals in the markets in which they coincide, its incentives to collude increase. It is therefore important to consider not only the number of multimarket contacts, but also their intensity. The recent reduction in the number of multimarket contacts and the increase in the intensity of these contacts in the Spanish banking context will therefore have increased the market power of the Spanish banks.

This chapter is organized as follows. Section 4.2 reviews the previous related literature on market power and multimarket contact. Section 4.3 examines the measurement of the Lerner index of market power, as well as the different measures of multimarket contacts. The sample, the variables used in the empirical analysis and a descriptive analysis of the variables are described in Section 4.4. The main results are presented in Section 4.5, and finally, Section 4.6 offers some conclusions and set out economic policy implications.

4.2. Literature Review

4.2.1. Market power

There are two approaches to analyze banking competition: a) a structural approach based on the *structure-conduct-performance* paradigm, which uses concentration indices as indicators of competition; and b) a non-structural approach that derives from the new empirical industrial organization literature, which estimates indicators of competition obtained from models of banks' behavior. The first approach, first seen in Bain's (1951) work, uses concentration indices such as the market share of a certain number of banks (CRi) or the Herfindahl index (HHI). The second approach uses indicators such as the Panzar and Rosse test (H-statistic), the Lerner index, the Rothschild-Bresnahan conduct index (also known as parameter, as in Corts, 1999), also interpreted as a conjectural variation, and the Boone competition indicator.

In the first approach, which includes the market share of a certain number of banks (CRi) and the Herfindahl index,[18] the market shares or concentration are used as indicators of competition. The underlying idea is that the fewer the banks in existence, the easier it is to behave in a non-competitive (collusive) way and therefore obtain monopoly or oligopoly rents. However, using concentration as an indicator of competition presents serious limitations, as evidenced in many studies,

[18] It is well known that the HHI has certain advantages over absolute indices such as CRi, since it considers the total number of rivals and its results are not sensitive to the number of banks included.

both theoretical and empirical. Demsetz (1973) shows that the increase in market share due to efficiency increases concentration, but there is no reason for less competition (*efficient structure hypothesis*). This requires including efficiency as an explanatory variable of profitability, in addition to market concentration. The recent study by Shaffer and Spierdijk (2017) finds that the calculation of market share is subject to measurement errors depending on how the market is defined. These authors also show that concentration as a measure of competition does not take causality into account, since a company's large market share may be due to entry barriers or to the fact that it is producing high quality products at lower prices than its rivals. Bos *et al.* (2017) find that the Herfindahl index is a biased indicator of competition, and distinguish two types of bias: the bias of omitted variables, since it has been shown that a company's conjectural variation (the degree to which firms expect their rivals to react to their production changes), in combination with its market share, is crucial to explain collusive rents (Stigler, 1964); and aggregation bias. These authors propose a new measure of market power, called "critical mass", which is defined as the market share needed for firms to achieve market power.

The second approach is based on the theory of the new empirical industrial organization and includes four indicators of competition: a) the Lerner index of market power; b) the Rothschild-Bresnahan index; c) the Panzar-Rosse H-statistic; and d) the Boone indicator. This approach adds additional theoretical foundations, taking as a starting point the problem of profit maximization.

The Lerner index is defined as the relative margin of the output price over the marginal cost in relation to the price, measuring firms'

capacity to fix a price above their marginal cost. When the price and the marginal cost coincide, the value of the index is zero, showing a situation of perfect competition. Positive Lerner index values indicate market power: the higher the index value, the greater the market power and, therefore, the loss of consumer welfare.[19] Two advantages of this indicator are that it offers a value at company level, and its approximation is more straightforward than other indicators of competition such as the Rothschild-Bresnahan conduct index. The Lerner index has been used widely in the literature, including by authors such as Angelini and Cetorelli (2003), Maudos and Fernández de Guevara, (2004), Fernández de Guevara *et al.* (2005), Fernández de Guevara and Maudos (2007), Carbó and Rodríguez (2007a), among others; some of the most recent applications are by Turk-Ariss (2010), Chen and Liao (2011), Cipollini and Fiordelisi (2012), Koetter *et al.* (2012), Bos *et al.* (2013), Anginer *et al*. (2014), Efthyvoulou and Yildirim (2014), Fu *et al.* (2014), and Fernández de Guevara and Maudos (2017).

However, the Lerner index also has limitations. Firstly, it does not consider the risk that banks face. Therefore, if a bank sets a higher interest rate as a result of the risk premium it applies, a higher marginal price-cost margin does not necessarily imply an increase in market power but may simply be due to an increase in the cost of risk. The cost of risk has been included in the estimation of the Lerner index only in a limited number of papers, such as Martín-Oliver *et al*. (2006), Jiménez *et al*. (2013) and Cruz-García *et al*. (2018). Jiménez

[19] Dansby and Willing (1979) show that the Lerner index is the slope of a social welfare function.

et al. (2013) construct a Lerner index corrected for risk following the approach of Martín-Oliver *et al*. (2006), using information (not publicly available) from the Bank of Spain on the probability of default. The study by Martín-Oliver *et al*. (2006) shows that there is an overestimation of market power when the risk premium is not considered in the calculation of marginal costs. Cruz-García *et al*. (2018) also include the cost of risk in their estimation of the Lerner index. The Lerner index does not shed light on the equilibrium quantities produced or consumed and how those quantities would change according to prices or costs. It would therefore be useful to supplement the Lerner index with other measures, one of which is the Lerner index adjusted for elasticity (Genesove and Mullin, 1998; Wolfram, 1999). This index is the Rothschild-Bresnahan conduct index (Rothschild, 1942; Bresnahan, 1982), calculated as the Lerner index multiplied by the elasticity of market demand. Like the Lerner index, the Rothschild-Bresnahan conduct index oscillates between 0 for the case of perfect competition and 1 for the case of monopoly. The Rothschild-Bresnahan conduct index has also been interpreted as a conjectural variation by various authors (Bowley, 1924; Iwata, 1974; Cowling and Waterson, 1976; Shaffer, 1983). On the cost side, the same difficulties are encountered in calculating this index as with the Lerner index. However, because the Rothschild-Bresnahan index estimate requires a structural model that incorporates both a supply equation and an aggregate demand equation, it needs more data than the Lerner index, which complicates its calculation.

Within the theory of contestable markets, developed by Baumol (1982) and Baumol *et al*. (1983), is the H-statistic formulated by Rosse and Panzar (1977) and Panzar and Rosse (1987). The H-statistic

analyzes the degree of response of income to changes in the prices of inputs, calculated as the sum of the elasticities of the incomes with respect to the price of each input. The original theoretical analysis derives equilibrium valuesfrom the H-statistic in a small number of special cases, which many of the later empirical studies have applied, implicitly assuming that they followed the pattern suggested by the authors in the original analysis: H = 1 corresponds to a perfect competition situation, H <0 corresponds to a monopoly, and H <1 to monopolistic competition. However, the literature has shown that neither the sign nor the magnitude of the Panzar and Rosse H-statistic can really identify the market type by itself, thus demonstrating that it is not a reliable measure of market power. In this line, the studies of Bikker *et al*. (2012), Shaffer and Spierdijk (2015), and Shaffer and Spierdijk (2017) can be highlighted. The latter analyzes a U.S. market that is known, a priori, to be a duopoly; the authors find that the estimates of Panzar and Rosse's H-statistic show that the market is competitive. In this same work, the Lerner index results indicate that the market is non-competitive, in line with a priori expectations. Despite the criticisms, this statistic has been used in various studies, such as Molyneux *et al*. (1994) for the major European countries between 1986 and 1989; Shaffer (2002) for a monopolistic bank in Texas from 1984 to 1999; Gelos and Roldos (2004) for emerging countries during the period 1994–1999; Claessens and Laeven (2004) for 50 countries' banking systems during the period 1994–2001; Shaffer (2004) for four banks (two in Kentucky and two in Texas) during the period 1984–1994; Anginer *et al*. (2014); Memić (2015) for the case of Bosnia and Herzegovina; Delis *et al*. (2016); and Apergis *et al*. (2016).

Boone (2008) developed an indicator of competition based on the intuition that firms bearing higher costs should, in theory, show relatively lower profitability in more competitive markets despite the origin of a possible market power (number of rivals or behavior patterns). For the calculation of the Boone index, the market share or profitability of each bank is regressed against its marginal costs, where the value of the Boone indicator is the estimated parameter that accompanies the marginal costs. Therefore, the higher the absolute value of the parameter, the greater the competition. The results of the Boone indicator can be influenced by measurement error in the sample data, as well as by the market definition used. This measure has been applied in papers such as van Leuvensteijn *et al*. (2011), Delis (2012) and Fernández de Guevara and Maudos (2017), among others.

Due to the complexity in the approximation of the Rothschild-Bresnahan conduct index, the three most frequently used indicators are the Lerner index, the Panzar-Rosse H-statistic and the Boone indicator. Given the problems presented by both the H-statistic and the Boone indicator, we opt to use the Lerner index, considering that it is important to capture the risk differences between firms in order to be a reliable indicator of competition. Additionally, the Lerner index has the advantage that it measures the market power enjoyed by each firm in the market, rather than the aggregated market indicator provided by the other two indicators.

Some notable papers in the literature analyzing banking competition for the Spanish case are Maudos and Pérez (2003), who base their results on the Lerner index and the Panzar-Rosse H-statistic; Salas and Saurina (2003), who analyze the effect of deregulation on the market power approximated by Tobin's q, finding that greater

market power is related to higher bank solvency ratios and lower credit risk losses; Carbó and Rodríguez (2007a), who analyze the market power and its determinants using different indicators of competition; Carbó *et al*. (2009), who analyze market power as a determinant of credit availability using the Lerner index and market concentration; and Jiménez *et al*. (2013), who analyze the relationship between bank competition and financial stability using the Lerner index, corrected for credit risk, and concentration indicators. More recently, Cruz-García *et al.* (2018), analyze recent developments in banking concentration and competition (also using the Lerner index corrected for credit risk) in Spain, providing information at the provincial level.

4.2.2. Multimarket contact

As we defined in the previous section, multimarket contact exists when firms operate at the same time in different geographical markets. This multiplicity of contacts may potentially affect the way in which they compete.

The main hypothesis derived from this literature is the negative effect of multimarket contacts on competition. Edwards's (1955) seminal paper postulates that firms operating in the same geographical markets may have less incentive to compete in a given market if they fear reprisals from their rivals not only in that market, but in all the markets in which they coincide. This could reduce the level of general competition in the market if all firms behave in a similar way. Therefore, banks could establish higher prices than they would in a competitive environment. Since Edwards's (1955) paper first

appeared, a strand of the related literature has considered the negative effect of multimarket contact on competition.

Many of these studies provide additional theoretical support for the possibility of collusion between firms in the presence of multimarket contacts. For example, Bernheim and Whinston (1990) demonstrate the negative relationship between multimarket contact and competition when there are asymmetries in the markets in which the firms interact or between firms. Spagnolo (1999) obtains a similar result, demonstrating that multimarket contact can facilitate collusion, regardless of whether or not asymmetries exist.[20] Tirole (1988) presents an example of how collusion between firms changes with multimarket contacts. Additional evidence on the positive relationship between multimarket contact and market power can be found in Matsushima (2001), Thomas and Willig (2006), and Sorenson (2007), among others.

There is a vast literature analyzing the effect of bank multimarket contact on different outcomes, reaffirming the negative relationship between multimarket contact and competition among banks. Heggestad and Rhoades (1978) and Whalen (1996) carry out an analysis for U.S. banks. Pilloff (1999) analyzes the effect of multimarket contact on bank profitability for U.S. banking firms during the period 1992–1995. Barros (1999) analyzes whether the collusive behavior between Portuguese banking firms derived from multimarket contacts has an effect on deposit interest rates. Haveman

[20] Although the first theoretical approaches to the study of multimarket competition suggested that certain conditions must exist for collusive behavior to emerge, subsequent studies, such as Spagnolo (1999), have shown that such behavior can occur in a wide range of situations, which makes it possible to extend the scope and applicability of the theory.

and Nonnemaker (2000) analyze the effect of multimarket contact on the competitive behavior of the incumbents in a market and of entrants into new markets, studying 321 savings and loans associations operating in 58 counties in California. They find an inverted U-shaped relationship between multimarket contact and entry rates. Hannan and Prager (2004) analyze the pricing behavior of single-market banks that face competition from multimarket banks for the U.S. banking industry in two different years: 1996 and 1999. Hannan (2006) analyzes the determinants of deposit-related retail banking fees using two surveys in 1999 and 2001. Their results show that banks in more concentrated markets tend to charge higher fees, and this effect is weaker when there is a strong presence of large multimarket banks. Coccorese and Pellecchia (2009) explore the effect of the multimarket contact on profitability for the Italian banking industry in the period 2002–2005. Coccorese and Pellecchia (2013) use a model of simultaneous equations to analyze the effect that multimarket contact has on the degree of market power and for twenty Italian regions during the period 1997–2009. Molnar *et al*. (2013) study competitive behavior in the Italian retail banking industry, using a structural model of demand and supply side of the deposit market.

In addition, in this branch of literature several studies suggest the existence of a non-linear relationship between multimarket contact and competition, namely, this relationship would have an inverted U-shape. This would imply that only when firms reach a given threshold of multimarket contacts would collusive behaviors appear (Gimeno and Woo, 1996; Baum and Korn, 1999; Haveman and Nonnemaker, 2000; Stephan *et al*. 2003; Fuentelsaz and Gómez, 2006).

However, although most of the literature stresses the positive relationship between multimarket contact and collusive behavior among banks (and therefore less competition), other studies support the hypothesis that multimarket contacts increase competition. This perspective was first presented by Solomon (1970), who maintains that multimarket contacts may have procompetitive effects if interbank rivalry is intense in individual local markets throughout a given region.

After Solomon's (1970) contribution, other authors have reached similar conclusions in analysis for the banking industry, including Whitehead (1978), Alexander (1985); Mester (1987) and De Bonis and Ferrando (2000), among others. Rhoades and Heggestad (1985) modified their previous study (Heggestad and Rhoades, 1978) using profits and prices as measures of rivalry in the banking market and finding mixed results. Degl'Innocenti *et al*. (2014) reject the hypothesis that mutual forbearance affects market conditions through greater multimarket contact in the Italian leasing sector. The recent paper of Kasman and Kasman (2016) analyzes the impact of multimarket contacts among banks on market power and stability in the Turkish banking industry between 2002 and 2012. Their results show that the measures of multimarket contacts are negatively related to market power, finding a non-linear relationship.

For the specific case of Spanish banking industry, Fuentelsaz and Gómez (2006) analyze the entry decisions for the Spanish savings bank industry between 1986 and 1999. They find the same result as Haveman and Nonnemaker (2000): an inverted U-shaped influence of multimarket contact on entry rates into new geographical markets. For the Spanish bank loan market between 1992 and 1998, Mas-Ruiz and

Ruiz-Moreno (2011) analyze the relationship between a company's belonging to a strategic group and its the rivalry and performance, finding that it is more likely that the group of larger companies (which are the ones that interact in a greater number of markets) will try to coordinate their actions, thus improving their performance. Gómez *et al*. (2017) analyze the effect of multimarket competition spillovers on bank performance and find that multimarket competition has indirect effects on the performance of other firms, but only if they belong to the same strategic group.

The results of studies[21] of the effect of multimarket contact on competition in industries other than banking clearly indicate that multimarket contact can reduce competition (see the complete review of the literature in Yu and Cannella, 2013). As already shown, although many studies have tried to empirically analyze the effect of multimarket contact on competition in the banking industry, the results are not conclusive, and fail to resolve the ambiguity characterizing the theoretical work. It is therefore necessary to analyze this issue in the banking sector through an empirical approach. As mentioned in the introduction, the Spanish banking sector is a good laboratory, particularly since the beginning of the financial crisis, as it has undergone a severe restructuring process that has significantly reduced its number of branches and, therefore, contact between competitors.

[21] Some notable examples are Evans and Kessides (1994), Gimeno and Woo (1996), Baum and Korn (1996), Singal (1996), Gimeno (2002), Miller (2010), Bilotkach (2011) and Ciliberto and Williams (2014) for airlines; Parker and Röller (1997), Busse (2000) and Fuentelsaz *et al.* (2014) for the telephony industry; Fernández and Marín (1998) and Silva (2015) for the hotel industry; Waldfogel and Wulf (2006) for the radio sector; Jans and Rosenbaum (1996) and Raventós and Zolezzi (2016) for the cement industry.

In addition, in previous empirical studies on multimarket contacts in the banking industry, the multimarket contact indicator is computed considering the number of contacts between firms, either through count measure (Heggestad and Rhoades, 1978; Rhoades and Heggestad, 1985; Whalen, 1996; De Bonis and Ferrando, 2000; Haveman and Nonnemaker, 2000; among others) or via probabilistic measure (Mester, 1987; among others). A few authors have calculated multimarket contact indicators by weighting them according to firm characteristics. Pilloff (1999), for example, measures multimarket contacts at the market level in the traditional way and constructs another measure weighting the first one by the deposits in each market. In turn, Coccorese and Pellecchia (2009) compute three alternative multimarket contact indicators at the firm level. The first one is computed considering only the number of contacts between firms. The other two multimarket contact indicators are calculated by weighting them by the similarity between the firms in terms of market share and the size of rivals, respectively. Kasman and Kasman (2016) use these same indicators in their analysis. Degl'Innocenti *et al*. (2014) also use two of the three indicators proposed by Coccorese and Pellecchia (2009). Fuentelsaz and Gómez (2006), in addition to the traditional multimarket contact indicator at the firm level, computed another by weighting the traditional indicator by the reciprocity of the contacts. Hannan and Prager (2004) and Hannan (2006) construct an indicator that considers rivals' market share. Coccorese and Pellecchia (2013) build their multimarket contact measures, at market level, weighting the traditional multimarket contact indicator by the market share of the banks operating in the markets, as well as by the concentration index. Gómez *et al*. (2017) compute the traditional

indicator and obtain an additional indicator at the firm level by weighting the traditional one by a factor reflecting that rivals are more important, the larger the number of markets in which they coincide with the firm.

In the next section we review an indicator commonly used in the literature and propose a new indicator that not only considers the coincidence of banks in the markets, but also the intensity of the contact in terms of branches.

4.3. Measuring Market Power, Multimarket Contact and Intensity of Multimarket Contact

4.3.1. Market power: the Lerner index corrected for credit risk

The Lerner index analyzes the capacity of a bank to set a price above its marginal cost, so that the higher this margin, the greater its market power (and therefore, the greater the loss of consumer welfare). As the difference between the price and the marginal cost increases, the market power rises, the extreme case being when the index value is equal to one (the marginal cost would be zero), showing a monopoly situation.

Specifically, the Lerner index is defined as:

$$L_{it} = \frac{(P_{it} - MC_{it})}{P_{it}} \tag{4.1}$$

where P_{it} is the average price of the output of bank i in year t and MC_{it} is the marginal cost. The most frequent empirical approach uses the

total assets of the bank as banking output, estimating its price as the ratio between total income and total assets. The underlying assumption is that the flow of goods and services that banks produce is proportional to their total assets, generating financial and non-financial income.

The traditional approximation of the Lerner index has the limitation that it takes no account of the risk banks face. If a bank sets a higher interest rate as a result of the risk premium it applies, a higher price-marginal cost margin does not necessarily imply greater market power, but may simply reflect the higher cost of risk. For that reason, following Cruz-García *et al.* (2018), the marginal cost is calculated based on the following translog cost function corrected for credit risk:

$$\begin{aligned} lnC_{it} = {} & \alpha_0 + \alpha_1 lnTA_{it} + \frac{1}{2}\alpha_k (lnTA_{it})^2 + \sum_{j=1}^{4} \beta_j lnw_{jit} \\ & + \frac{1}{2}\sum_{j=1}^{4}\sum_{k=1}^{4} \beta_{jk} lnw_{jit} lnw_{kit} \\ & + \frac{1}{2}\sum_{j=1}^{4} \gamma_j lnTA_{it} lnw_{jit} + \mu_1 Trend + \frac{1}{2}\mu_2 Trend^2 \\ & + \mu_3 Trend\ lnTA_{it} + \sum_{j=1}^{4} \delta_j Trend\ lnw_{jit} + v_i + u_{it} \end{aligned} \tag{4.2}$$

where *C* is the total costs (financial costs, operating costs and provisions (as an ex-post approximation of the cost of risk)), *TA* is total assets, *Trend* reflects the effect of technological change (which translates into displacements of the cost function over time), v_i are the

fixed effects and u_{it} is a random disturbance. Lastly, *w* is the price of the production factors, which are measured as follows:

- w_1: Price of labor = staff costs/number of employees.
- w_2: Price of lendable funds = financial costs/lendable funds.
- w_3: Price of capital = operating costs (except staff costs)/fixed assets.
- w_4: Price of credit risk = financial asset impairment losses/volume of lending.

In line with common practice, we estimate Equation (4.2) imposing conditions of symmetry and grade one homogeneity on input prices.[22]

4.3.2. Multimarket contact and its intensity

The calculation of the average multimarket contact is carried out following Coccorese and Pellecchia (2009), considering the area delimited by a zip code as the local market (Degl'Innocenti *et al*., 2014; Kasman and Kasman, 2016).

First, we calculate the most widely used indicator of multimarket contact, based on the count of the contacts between banks. The average multimarket contact (*MMC*) variable for bank *i* is computed

[22] Note that the cost function differs from the traditional one in that in addition to the financial and operational costs, it includes the provisions that a bank makes each year, and this variable is a proxy ex-post of the cost of risk. Given that the cost is included in the dependent variable, it was necessary to include the unit cost of this productive input, which we can call "risk", as a determinant, approximating as a ratio between financial asset impairment losses and the volume of lending.

as the total number of contacts of bank *i* with other banks divided by the number of banks that bank *i* coincides with:[23]

$$MMC_i = \frac{\sum_{j \neq i} m_{ij} \delta_{ij}}{\sum_{j \neq i} \delta_{ij}} \tag{4.3}$$

where m_{ij} indicates the number of markets in which the bank *i* coincides with bank *j* and δ_{ij} takes value 1 if $m_{ij} > 0$ (if bank *i* coincides with bank *j* in at least one market) and 0 if $m_{ij} = 0$ (if bank *i* and bank *j* do not coincide in any market). The numerator of Equation (4.3) is the total number of contacts that bank *i* has with all other banks, whereas the denominator indicates the number of different banks that bank *i* coincides with. Therefore, MMC_i indicates the average number of contacts bank *i* has with its rivals. The MMC_i index, theoretically, can range between zero (for the case that the bank is a monopolistic bank in the markets where it operates) and the total number of local markets (for the case that all banks operate in all areas delimited by a zip code).

The MMC_i indicator only considers the existence of contact, that is, if banks coincide in markets, regardless of the number of branches involved in the contact. However, contacting a few or many rival branches, with few or many of their own branches, may not have the same effect in terms of competition outcomes. We therefore propose an additional indicator which considers the number of branches the bank has in relation to the number of its rivals' branches in each

[23] For more information about the calculation of *MMC*, we refer readers to Coccorese and Pellecchia (2009). These authors also provide a numerical example of how this multimarket contact measure is calculated.

market in which they coincide. That is, the strength/weakness of the bank in terms of its number of branches compared to those of its rivals. In addition, each market is weighted according to its weight in the bank's branch network. The higher the value of this indicator for a bank, the lower the intensity of the multimarket contacts of that bank.

To construct the intensity of the multimarket contact (*IMMC*) indicator, we again consider the relevant market to be the area delimited by a zip code. For each year, the starting point is matrix **D**, of dimension *K*N*, which describes the geographical distribution of banks' branches:

$$\mathbf{D} = \begin{bmatrix} d_{11} & \dots & d_{1K} \\ \vdots & \ddots & \vdots \\ d_{N1} & \dots & d_{NK} \end{bmatrix}.$$

Considering that *K* is the number of markets (areas delimited by a zip code, in our case), *N* the number of banks, the generic term d_{ik} (with $k = 1,\dots,K$) of matrix **D** is the number of branches of bank *i* in market *k*.

From this matrix, matrix **C** is constructed, which indicates whether bank *i* operates in market *k*. The elements of matrix **C** take values zero or one, where $c_{il}=1$ if $d_{ik}>0$, and $c_{ik}=0$ if $d_{ik}=0$. That is, a value of $c_{ik} = 1$ means that bank *i* operates in market *k*.

$$\mathbf{C} = \begin{bmatrix} c_{11} & \dots & c_{1K} \\ \vdots & \ddots & \vdots \\ c_{N1} & \dots & c_{NK} \end{bmatrix}.$$

After that, we can define the following *N x N* matrix **M´**:

$$\mathbf{M}' = \begin{bmatrix} m'_{11} & \dots & m'_{1N} \\ \vdots & \ddots & \vdots \\ m'_{N1} & \dots & m'_{NN} \end{bmatrix},$$

where each element is calculated as follows:[24]

$$m'_{ij} = \sum_{k=1}^{K} \left[\left[\frac{d_{ik}}{d_{jk}} \cdot c_{ik} \cdot c_{jk} \right] \cdot \frac{d_{ik}}{\sum_{k=1}^{K} d_{ik} \cdot c_{ik} \cdot c_{jk}} \right] \quad (4.4)$$

d_{ik} and c_{ik} have been defined previously; $\frac{d_{ik}}{d_{jk}}$ is the ratio of the number of branches of bank *i* and the number of branches of rival *j* in market *k*. Therefore, the first term in brackets indicates the relative number of branches of two rivals (bank *i* and bank *j*) in a given market considering the fact that both banks operate in that market. The second term in brackets on the right side of Equation (4.4) is the relative relevance of market *k* for the bank among all the markets in which both banks *i* and *j* coincide. Therefore, each element m'_{ij} of matrix **M´** is the strength/weakness of bank *i* in terms of branches with respect to those of its rivals, that is, the intensity of the multimarket contacts of bank *i* in terms of the number of branches of bank *j*, correcting for the number of branches of bank *i* in each market, as well as for its branch network. The higher the value, the lower the intensity of the multimarket contacts for bank *i*.

Then, the following matrix of weights **P** is calculated:

[24] To correctly define matrix **M'** we assume that $\left[\left[\frac{d_{ik}}{d_{jk}} \cdot c_{ik} \cdot c_{jk} \right] \cdot \frac{d_{ik}}{\sum_{k=1}^{K} d_{ik} \cdot c_{ik} \cdot c_{jk}} \right]$=0 if d_{jk}=0 or if $\sum_{k=1}^{K} d_{ik} \cdot c_{ik} \cdot c_{jk}$=0.

$$\mathbf{P} = \begin{bmatrix} p_{11} & \cdots & p_{1N} \\ \vdots & \ddots & \vdots \\ p_{N1} & \cdots & p_{NN} \end{bmatrix},$$

where the elements of the diagonal are zero and the rest of the elements are calculated as follows:

$$p_{ij_{(i \neq j)}} = \sum_{k=1}^{K} \left[d_{jk} \cdot c_{ik} \cdot c_{jk} \right]. \tag{4.5}$$

Then, we constructed matrix **P'** as follows:

$$\mathbf{P'} = \begin{bmatrix} p'_{11} & \cdots & p'_{1N} \\ \vdots & \ddots & \vdots \\ p'_{N1} & \cdots & p'_{NN} \end{bmatrix},$$

where the elements of this matrix are calculated in the following way:[25]

$$p'_{ij} = \frac{p_{ij}}{\sum_{j \neq i} p_{ji}} \tag{4.6}$$

Finally, we obtain matrix **F** as the product of matrix **M'** and matrix **P'**:

$$\mathbf{F} = \mathbf{M'} \cdot \mathbf{P'} = \begin{bmatrix} f_{11} & \cdots & f_{1N} \\ \vdots & \ddots & \vdots \\ f_{N1} & \cdots & f_{NN} \end{bmatrix},$$

where the average intensity of the multimarket contacts (*IMMC*) index for bank *i* is the corresponding element of the diagonal:

[25] To correctly define matrix **P'** we assume that p'_{ij}=0 if $\sum_{j \neq i} p_{ji}$=0.

$$IMMC_i = f_{ii} \tag{4.7}$$

The greater the index, the greater the proportion of branches of bank *i* compared to those of rival bank *j*, so the intensity of the multimarket contacts of bank *i* will be lower because bank *i* dominates bank *j* and bank *i* may not consider the actions of bank *j* to be a threat. For example, if the *IMMC* for a bank takes a value of 2, it would mean that the rivals' branch network is on average half that of the bank's branch network in the markets in which they coincide and that bank is, therefore, in a situation of strength in terms of branches. In contrast, if the index is below 1, the bank has a lower number of branches on average than its rivals in the markets in which they coincide, and it is in a situation of weakness in terms of branches.

Appendix 4.A shows a numerical example of how *IMMC* is calculated.

4.4. Sample, Variables and Descriptives

4.4.1. Sample

This study analyzes a panel dataset comprising practically all Spanish deposit-taking institutions over the period 2006–2017. This database combines information from different sources. The information about bank-specific characteristics is taken from the balance sheet and the income statement of the yearbooks of the AEB, CECA and UNACC. These yearbooks provide annual financial information for the Spanish banks, saving banks and credit unions, respectively. The financial statements used are unconsolidated

(domestic business in Spain), since only the branches located in Spain are of interest to this analysis. The geographical location of bank branches comes from the annual *Guía de la banca, cooperativas de crédito y cajas de ahorro* published by Maestre-Edibán. Banks for which there was no information on any of the explanatory variables, as well as those for which outliers appeared in some of the required variables, were excluded from the sample. To carry out the econometric regressions of the empirical analysis, the negative values of the Lerner index corrected for credit risk were also eliminated, since they are due to an exceptional balance-sheet clean-up that took place in 2012 for regulatory purposes. After filtering, the panel data used has 1,375 observations.

4.4.2. Variables

As already mentioned, the objective of the chapter is to analyze the determinants of the market power of Spanish banks during the period 2006–2017. The dependent variable will be the Lerner index corrected for credit risk as described in the previous section. As the determinants of the Lerner index we consider the standard Monti-Klein model for the case of oligopolistic competition, which shows that the Lerner index of market power depends on the number of rivals and the elasticity of demand. Following a conjectural variation approach, in which firms form expectations (conjectures) about the reactions (variations) of the others, these variations would also be part of the determinants of market power. In addition, the standard model has been extended in other papers with the aim of incorporating additional explanatory variables of market power. Thus, Corvosier and

Gropp (2002), Fernández de Guevara *et al.* (2005) and Fernández de Guevara and Maudos (2007), among others, show that the Lerner index of market power depends on the specific variables of the bank, market concentration and demand elasticity.

As potential determinants of the Lerner index, we include structural characteristics of the market (market concentration and GDP growth), bank-specific variables[26] and the multimarket contact variables as proxies of the conjectural variation. More precisely, the following variables are included:

Market variables

Market concentration

To test the traditional *structure-conduct-performance* paradigm, a variable is included to proxy market concentration, in this case the Herfindahl-Hirschman index (*HHI*). For a generic market *k*, the HHI calculated for the distribution of branches is given by:

$$HHI_k = \sum_{i=1}^{N_k} \left(\frac{d_{ik}}{\sum_{i=1}^{N_k} d_{ik}} \right)^2 \tag{4.8}$$

where N_k is the number of banks that operate in market *k*, and d_{ik} is the number of branches of bank *i* in market *k*. The *HHI* indexes are calculated for each zip code. For each bank in the sample, the concentration is calculated weighting the value of concentration in

[26] Given that the Lerner index we use as a dependent variable already considers credit risk, we do not include a variable to approximate the default risk, in line with the related empirical literature.

each market according to the distribution of the bank's branch network.

GDP growth

GDP growth rate is included to capture the possible influence of the economic cycle as a proxy of the elasticity of the demand for banking products. At the bank level, the variable is constructed by weighting the GDP growth of each Spanish province[27] according to the provincial distribution of the branch network of the bank analyzed.

Bank-specific variables

Liquid reserves

Following Fernández de Guevara and Maudos (2007), to proxy the coefficient of bank liquid reserves we use the ratio between cash and deposits in central banks and total deposits. The expected sign of this variable is negative since a larger volume of liquid reserves means a higher opportunity cost of investing these funds in more profitable assets.

Efficiency

To test the *efficient structure hypothesis* (Demsetz, 1973), a variable that proxies efficiency is included as an explanatory variable. We proxy the banks' efficiency by the cost to income ratio, that is, the ratio between operating costs and gross income. A higher ratio implies

[27] Unfortunately, GDP growth is not available by zip code areas or even by municipalities.

lower efficiency. The expected sign of this variable is therefore negative, since a higher inefficiency reduces profitability and eventually market power.

Asset composition

Following Coccorese and Pellecchia (2009) and Kasman and Kasman (2016), we include the bank's asset composition, approximated by the ratio of customer loans to total assets. The expected sign is positive, as more loans reflect higher potential gross yield, which translates into greater market power.

Equity ratio

The ratio between shareholders' equity and total assets is also included, following Coccorese and Pellecchia (2009), Degl'Innocenti *et al*. (2014) and Kasman and Kasman (2016), among others. Since well-capitalized banks are more solvent and have a reduced probability of bankruptcy, they can raise funds at a lower cost, thus increasing their market power. The expected sign of this variable is therefore positive.

Conjectural variation variables

Multimarket contacts

To compute the contacts among banks we use Coccorese and Pellecchia's (2009) multimarket contact measure described in the previous section. A higher value of this variable implies a greater number of multimarket contacts. Therefore, a positive sign would

confirm the hypothesis of collusion and a negative sign would reject it.

Intensity of multimarket contacts

A value of this variable above 1 implies that the bank has on average a greater number of branches than its rivals in the markets in which it operates; that is, the bank faces lower multimarket contact intensity and is in a position of strength in terms of number of branches. Conversely, a value of the variable below 1 means that on average the bank has a lower number of branches than its rivals in the markets where they coincide, and faces greater multimarket contact intensity, meaning that it is in a weak position in terms of the number of branches. This indicator therefore allows us to test the different hypotheses of the models of oligopolistic market structure with dominant firms in the market. The indicator of the intensity of multimarket contact, IMMC, measures the bank's position in the markets in which it operates as compared to its rivals, thus indicating whether the bank is in a dominant- or a weak-fringe position. This allows us to test for the existence of *dominant-fringe* behavior. In the context of conjectural variations in asymmetric interaction models, we can distinguish between Stackelberg *leader-follower* behavior and *dominant-fringe* behavior (Spiller and Favaro, 1984; Putsis and Dhar, 1998; among others). *Leader-follower* behavior implies that the follower firm reacts to changes in the leader's strategy, while the leader firm does not react to the followers' strategy. By contrast, in a *dominant-fringe* setting a dominant firm expects strong retaliation from other dominant firms and accommodation from the fringe firms. A fringe firm expects some small retaliation from the dominant firms

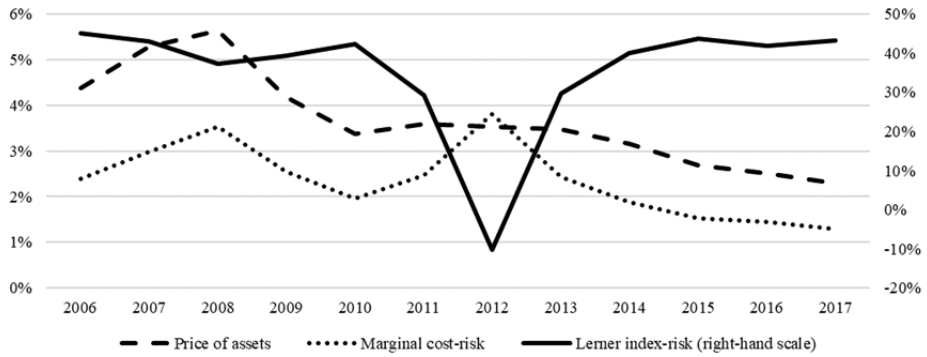
with no reaction from the other fringe firms in the event of a change in its strategy. Therefore, dominant firms fiercely defend their position in the market through competitive behavior, while the fringe companies could simply follow or adapt to the actions of the dominant firms. If *dominant-fringe* behavior is observed, the expected effect of IMMC on market power is negative, since the firms with greater strength (dominance) will show more competitive behavior to maintain their position.

4.4.3. Descriptives

Figure 4.1 shows the evolution of the Lerner index corrected for credit risk of the Spanish banking industry, as well as the evolution of its components: price of output and marginal costs. As the Lerner index is a bank-specific variable, the aggregate of the sector is an average of the individual indices. Various stages can be identified from the evolution of the Lerner index of the Spanish banks. In the years of expansion, until 2008, the index falls, implying that prices increased to a lesser extent than marginal costs. With the change of cycle, the market power increases in 2009 and 2010, and experiences a slight fall in 2011. The Lerner index corrected for risk falls sharply in 2012 (reaching, in some cases, negative values). This is due to the exceptionally high value of marginal costs in that year as a result of the also exceptional balance-sheet clean-up that took place with the approval of two royal decree-laws that brought in strict provisions in the exposure of the construction and real-estate sectors. As a result, asset impairment losses amounted to 83,000 million euros in financial assets and 33,000 million euros in other assets. In subsequent years,

the marginal cost decreases as the asset impairment loss falls, causing the Lerner index corrected for risk to gradually return to normal values. Since 2015, market power values have remained similar to initial values. Overall, the Lerner index fell before the crisis, but increased again once the crisis began, almost recovering the initial values of the period.

Figure 4.1. Evolution of the Lerner index corrected by risk of the Spanish banking industry and its components.

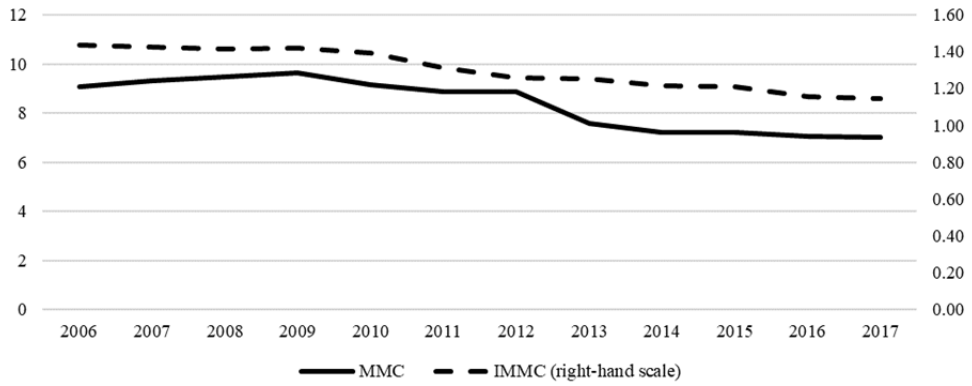


Source: AEB, CECA, UNACC and authors' calculations.

Figure 4.2 displays the evolution of the *MMC* index and the evolution of the intensity of multimarket contacts (*IMMC*) for the Spanish banking industry. The figure shows the average indexes across banks; this reveals that the measure of multimarket contact (*MMC*) oscillates around the 8.37 value, meaning that banks coincide with their rivals in 8.37 markets on average. The evolution of the *MMC* shows an upward trend until 2009, coinciding with the expansionary years in the cycle before the financial crisis. The number of branches in the Spanish banking sector increased by 5.43% between 2006 and 2008, which translated into an increase in the

contact among banks in the markets. The trend in the *MMC* index changed with the onset of the financial crisis, since when it has fallen continuously. In the case of the Spanish banking industry, this change in the trend coincided with the first round of interventions of the Fund for the Orderly Restructuring of the Banking Sector (FROB), the authority in charge of the resolution of credit institutions. Since 2008, banks in Spain have been restructured, beginning a process of reduction of their productive capacity with the subsequent closure of branches. Between 2008 and 2017 the number of Spanish bank branches fell by 40.34%. Associated with this fall in the number of branches, multimarket contact also shrank (-26.14% between 2008 and 2017). This decrease in the number of average contacts coincides with the increase in the Lerner index after the crisis, with the exception of 2012. An inverse relationship is therefore observed between the evolution of the *MMC* and the Lerner index in the post-crisis period.

Figure 4.2. Evolution of MMC and IMMC measures.



Source: Guía de la banca, cooperativas de crédito y cajas de ahorro published by Maestre-Edibán and authors' calculations.

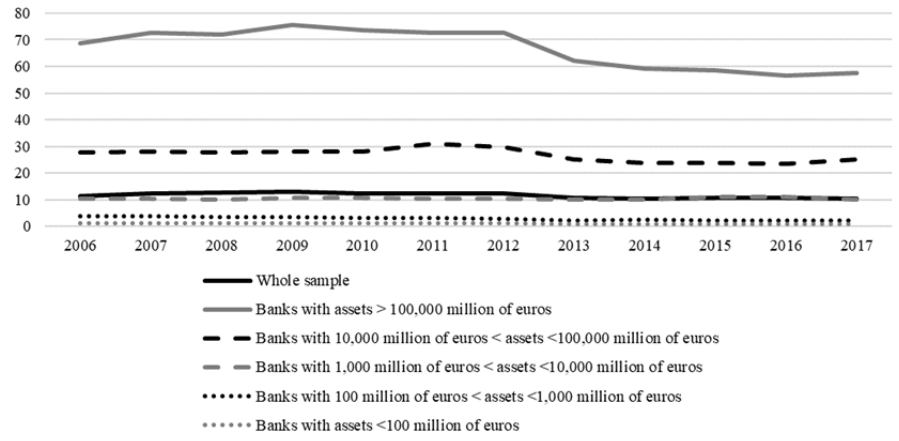
Figure 4.2 also shows that the measure of the intensity of multimarket contacts (*IMMC*) oscillates around the 1.30 value, on average, meaning that on average the bank has 30% more branches than its rivals, considering the importance of each market in the bank branch network. The evolution of the *IMMC* also shows a change in trend in 2009: it remained stable until 2009, after which it began its downward trend.

Figure 4.3 shows the different measures of the intensity of multimarket contacts by size. The sample is divided into banks with less than 100 million euros of total assets, banks between 100 million and 1,000 million euros, banks between 1,000 and 10,000 million euros, banks between 10,000 and 100,000 million euros and banks with more than 100,000 million euros. In the case of the *MMC*, large banks have more multimarket contacts than the average for the whole sample. Banks with more than 100,000 million euros are, by far, those with the highest number of multimarket contacts. This is because large banks are present in more markets and, in addition, many of these markets have low levels of concentration; that is, the number of rivals' branches is high in the markets where they operate. Below the average are the smallest banks, with a lower *MMC* in accordance with their smaller size. In any case, there is a clear relationship between multimarket contact and bank size, although large banks clearly dominate.

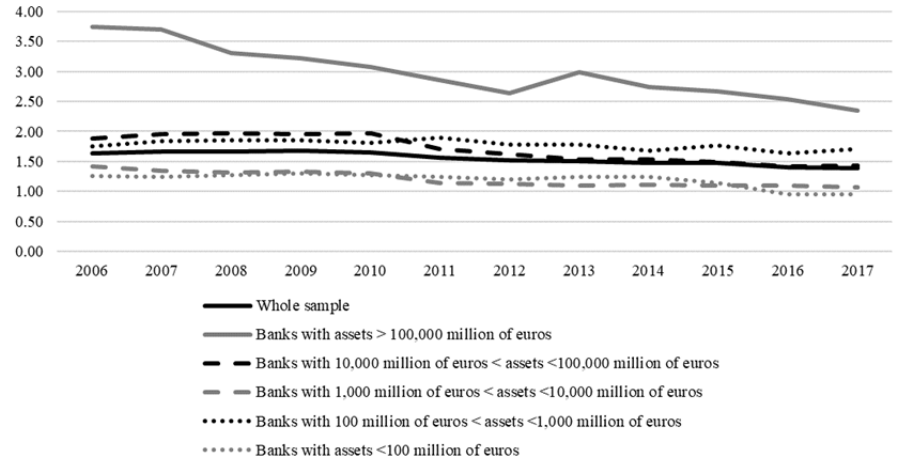
In the case of the *IMMC*, large banks have higher values, above the average, indicating that they have more branches than their rivals. Therefore, large banks face a situation of lower multimarket contact intensity. Banks with more than 100,000 million euros are, by far,

Figure 4.3. MMC and IMMC measures by size of banks in terms of assets.

a) MMC



b) IMMC



Source: AEB, CECA, UNACC, Guía de la banca, cooperativas de crédito y cajas de ahorro published by Maestre-Edibán and authors' calculations.

those in a position of greater strength in terms of branches. Below the average are the smallest banks, with lower values of *IMMC* in accordance with their smaller size. In any case, there is also a clear relationship between the intensity of multimarket contact and bank size.

Table 4.1 illustrates the descriptive statistics of the sample used in the empirical analysis and Table 4.2 reports the correlation matrix. The average *Lerner index* is lower during the crisis than in pre-crisis years. However, after the crisis, the Lerner index average increases to values above those observed before the financial crisis. The *MMC* and *IMMC* fall during and after the financial crisis, due to the bank branch closures in Spain since 2008. Turning to the control variables, market concentration (*HHI*) increased after the crisis due to the exceptional closing of branches as a result of the restructuring process in the Spanish banking sector. Bank liquidity increased after the crisis, possibly due to the new liquidity requirements of Basel III, which were gradually required from 2015 onward. Spanish banks, on average, showed higher inefficiency during and after the crisis than in pre-crisis years. The ratio of loans to total assets decreased during and after the crisis, falling to a much lower level in the latter period. This is due, in part, to the credit restrictions imposed in Spain. During and after the crisis, the equity/assets ratio has higher average values than before the crisis. Finally, GDP growth reached negative rates during the crisis, but recovered positive values afterwards.

Table 4.2 shows that the correlation coefficient of *MMC* and *IMMC* with the dependent variable is negative in both cases. The efficiency and the loan/assets ratio also have a negative correlation coefficient with the dependent variable. However, the Herfindahl

Table 4.1. Descriptive statistics.

	Whole period		Before the crisis: 2006-2008		During the crisis: 2009-2013		After the crisis: 2014-2017	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**	**Mean**	**Standard deviation**
				Measure of market power				
Lerner index (%)	39.8857	10.1581	41.3982	5.9105	35.1467	11.4852	45.5168	7.5023
				Measure of multimarket contact				
MMC	11.5370	16.0336	12.1293	15.5892	11.7877	16.8588	10.4454	15.2038
				Measure of the intensity of multimarket contact				
IMMC	1.5742	1.0789	1.6605	1.0864	1.5937	1.1262	1.4414	0.9801
				Control variables				
HHI	0.2723	0.0856	0.2573	0.0836	0.2581	0.0825	0.3041	0.0828
Cash/deposits (%)	2.9199	3.3068	2.3238	2.0137	2.5010	2.3342	3.9786	4.7364
Efficiency (%)	48.8859	14.7869	45.1871	11.0159	47.9776	13.3078	53.1490	18.0329
Loan/assets (%)	60.7284	15.3396	66.9518	14.5212	60.9837	15.5974	55.2910	13.5579
Equity/assets (%)	7.0353	3.0498	5.9051	2.6917	6.6542	2.8440	8.4790	3.0558
GDP growth (%)	1.8300	3.5733	6.1078	2.2406	-1.5952	1.3868	3.0012	1.2455

Note: All the averages are weighted by total assets except *MMC* and *IMMC,* since in the case of MMC and IMMC what is interesting is the average number of multimarket contacts and the average intensity of a contact, regardless of to which bank these values belong.

Source: AEB, CECA, UNACC, Guía de la banca, cooperativas de crédito y cajas de ahorro (published by Maestre-Edibán), and authors' calculations.

Table 4.2. Correlation matrix.

	Lerner index	**MMC**	**IMMC**	**HHI**	**Cash/ deposits**	**Efficiency**	**Loan/ assets**	**Equity/ assets**	**GDP growth**
Risk-corrected Lerner index	1								
MMC	-0.2996	1							
IMMC	-0.0696	0.2657	1						
HHI	0.1029	-0.0236	-0.0717	1					
Cash/deposits	0.1007	-0.0890	-0.0843	0.0338	1				
Efficiency	-0.4024	-0.0239	-0.0102	-0.0755	0.0426	1			
Loan/assets	-0.2559	0.2122	0.2106	0.0851	-0.2410	-0.0377	1		
Equity/assets	0.2806	-0.2278	-0.1614	-0.1466	0.0340	0.0514	-0.3149	1	
GDP growth	0.2351	-0.0093	-0.0182	-0.0060	0.0954	-0.0332	0.0407	-0.0060	1

Source: AEB, CECA, UNACC, Guía de la banca, cooperativas de crédito y cajas de ahorro (published by Maestre-Edibán), and authors' calculations.

index, the variable that proxies the liquid reserves, the capitalization of the bank and the GDP growth rate, has a positive correlation coefficient with the Lerner index.

4.5. Results

4.5.1. Determinants of the Lerner index

Table 4.3 reports the regression results using the measure of multimarket contact (*MMC*)[28] proposed by Coccorese and Pellecchia (2009). All the estimations are panel data estimations including individual effects. Regressions also include time effects to reflect how particular shocks in each year impact the dependent variable. The first column shows that the *MMC* has a significant negative coefficient, suggesting that higher multimarket contact may lead to lower bank market power. This result is in line with the findings of Degl'Innocenti *et al*. (2014) and Kasman and Kasman (2016), among others. This implies that when banks coincide in many markets, lower bank market power can result, rejecting the tacit collusion hypothesis. The regression results also show that bank market power and the concentration index are positively related and have a significant coefficient, suggesting that banks behave less strategically and compete less intensely in markets where concentration is high; the

[28] We tested the robustness of the results with the additional multimarket contact measures proposed by Coccorese and Pellecchia (2009). These additional indicators correct the *MMC* indicator for the similarity between each pair of banks in terms of market share, as well as for the size of the rivals. Results are similar to those shown in Table 3 and are available upon request.

Table 4.3. Determinants of Lerner index: 2006-2017 (I). Whole sample.

Dependent variable: Lerner index$_{it}$						
	OLS		**IV**		**Two-step GMM**	
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
Lerner index$_{i(t-1)}$					0.4770 ***	0.4695 ***
					(0.0749)	(0.0783)
MMC$_{it}$	-0.0018 ***	-0.0038 ***	-0.0019 ***	-0.0039 ***	-0.0011 ***	-0.0025 ***
	(0.0003)	(0.0007)	(0.0003)	(0.0007)	(0.0002)	(0.0005)
MMC$^2_{it}$		0.0000 ***		0.0000 ***		0.0000 ***
		(0.0000)		(0.0000)		(0.0000)
Market concentration (HHI)$_{it}$	0.0332 *	0.0373 **	0.0244	0.0290	-0.0056	-0.0023
	(0.0173)	(0.0168)	(0.0192)	(0.0186)	(0.0113)	(0.0112)
Cash/deposits$_{it}$	-0.0878	-0.0965	-0.1202 *	-0.1282 *	-0.1791 **	-0.1635 **
	(0.0711)	(0.0727)	(0.0698)	(0.0715)	(0.0782)	(0.0719)
Efficiency$_{it}$	-0.3117 ***	-0.3084 ***	-0.2960 ***	-0.2927 ***	-0.1849 ***	-0.1878 ***
	(0.0197)	(0.0196)	(0.0243)	(0.0242)	(0.0228)	(0.0235)
Loan/assets$_{it}$	-0.0192	-0.0073	-0.0374 *	-0.0239	-0.0717	-0.0207
	(0.0215)	(0.0223)	(0.0221)	(0.0228)	(0.0515)	(0.0184)
Equity/assets$_{it}$	0.4386 ***	0.4149 ***	0.4068 ***	0.3849 ***	0.2941 **	0.2247 **
	(0.0809)	(0.0762)	(0.0789)	(0.0744)	(0.1183)	(0.1086)
GDP growth$_{it}$	0.0828	0.0766	0.0257	0.0266	0.0384	0.0889
	(0.1333)	(0.1343)	(0.1446)	(0.1457)	(0.2322)	(0.2424)
Constant	0.6408 ***	0.6444 ***	0.7246 ***	0.7311 ***	0.3739 ***	0.3514 ***
	(0.0258)	(0.0254)	(0.0263)	(0.0268)	(0.0712)	(0.0576)
Number of obs.	1,375	1,375	1,172	1,172	1,061	1,061
R^2 within	0.4382	0.4401	0.4302	0.4312		
Arellano-Bond test for AR(1) in first differences [p-value]					-4.44 [0.000]	-4.36 [0.000]
Arellano-Bond test for AR(2) in first differences [p-value]					-0.29 [0.770]	-0.30 [0.766]
Hansen test of overid. restrictions [p-value]					47.41 [0.335]	51.24 [0.242]

* p<0.10, ** p<0.05, *** p<0.01.

Note: All estimations include time effects (not reported). The Hausman test assesses the appropriateness of the random-effects specification against the fixed-effects specification.

coefficient of the efficiency is also negative and statistically significant, suggesting that efficient banks enjoy higher market power than inefficient ones. These results confirm the *efficient structure hypothesis.* Finally, the most highly capitalized banks enjoy greater

market power, considering that the coefficient of the equity/assets ratio is positive and significant.

Following Fuentelsaz and Gómez (2006) and Kasman and Kasman (2016), among others, we also test a possible non-linear relationship between multimarket contact and the Lerner index using a quadratic term of the multimarket contact in the regression. The second column shows that the coefficient of the squared *MMC* variable is positive and significant, suggesting a non-linear relationship between the multimarket contacts among banks and their market power. Therefore, the relationship is U-shaped, which indicates that market power decreases until it reaches a certain level of *MMC*, after which it starts to increase. The minimum point of the U-shaped relationship between multimarket contacts and market power is 56.89. That is, market power decreases to levels below 56.89 and begins to increase once it reaches this value. The value of the calculated minimum is found between the 96th and 97th percentile of the distribution of the variable. This implies that the vast majority of banks in the sample are in the decreasing stretch of the curve, confirming a negative relationship between market power and multimarket contacts. The few banks that are in the rising stretch of the curve are the largest banks, which implies that only for these banks would a greater number of multimarket contacts lead to collusive behavior. The signs and significance of the rest of the variables are the same as in the previous finding.

Two additional robustness checks are carried out. First, to correct for potential endogeneity problems, the liquidity ratio, the efficiency indicator, the loan/assets ratio and the equity/assets ratio are instrumented with their lagged value. The results are displayed in the

third and fourth columns and are practically the same as in the previous regressions, without instrumentation, except for market concentration, whose coefficient loses significance, and for the liquid reserves, which now have a statistically significant coefficient. The loans to total assets ratio has also a significant coefficient in the first case, with a negative effect on market power.

Second, some authors consider that the estimated Lerner index has inertia as it depends on the income and expenses of banking operations carried out in the past. Therefore, the lagged endogenous variable is included as an additional regressor. The fifth and sixth columns report the results of the two-step GMM regressions (Arellano and Bond, 1991; Arellano and Bover, 1995; and Blundell and Bond, 1998). All the GMM equations are properly specified, as can be seen at the bottom of the table (first and second order autocorrelation and the Hansen test of over-identification). Possible endogeneity problems were corrected by using the lagged variables as instruments.[29] In both regressions, the coefficient of the lagged dependent variable is positive and significant, confirming the inertia in the trend in the market power. The results are essentially the same as in the previous regressions.

Table 4.4 reports the regression results using the intensity of multimarket contact measure (*IMMC*). This index measures the strength/weakness of a bank in terms of number of branches compared to that of rivals, depending on whether the index is above or below

[29] The Lerner index variable is instrumented with its second lag. The other potential endogenous variables (cash/deposits ratio, the efficiency, loan/assets ratio and equity/assets ratio) are instrumented with their first lag.

Table 4.4. Determinants of Lerner index: 2006-2017 (II). Whole sample.

Dependent variable: Lerner index$_{it}$

	OLS		IV		Two-step GMM	
	[1]	[2]	[3]	[4]	[5]	[6]
Lerner index$_{i(t-1)}$					0.5691 ***	0.4995 ***
					(0.0728)	(0.0826)
IMMC$_{it}$	-0.0054	-0.0206 *	-0.0069 *	-0.0257 **	-0.0252 **	-0.0155 **
	(0.0033)	(0.0109)	(0.0037)	(0.0118)	(0.0115)	(0.0074)
IMMC$^2_{it}$		0.0026 *		0.0032 **		0.0026 **
		(0.0015)		(0.0016)		(0.0013)
Market concentration (HHI)$_{it}$	0.0428 **	0.0473 ***	0.0342	0.0402 **	0.0845	0.0652
	(0.0185)	(0.0182)	(0.0209)	(0.0202)	(0.0592)	(0.0497)
Cash/deposits$_{it}$	-0.0836	-0.0838	-0.1174 *	-0.1176 *	-0.1239 **	-0.0360
	(0.0713)	(0.0713)	(0.0701)	(0.0702)	(0.0615)	(0.1466)
Efficiency$_{it}$	-0.3039 ***	-0.3050 ***	-0.2866 ***	-0.2883 ***	-0.1635 ***	-0.1640 ***
	(0.0206)	(0.0206)	(0.0247)	(0.0249)	(0.0253)	(0.0229)
Loan/assets$_{it}$	-0.0198	-0.0175	-0.0403 *	-0.0371	-0.0144	-0.0613
	(0.0225)	(0.0228)	(0.0233)	(0.0236)	(0.0190)	(0.0568)
Equity/assets$_{it}$	0.5026 ***	0.4960 ***	0.4721 ***	0.4633 ***	0.3640 ***	0.4317 ***
	(0.0948)	(0.0942)	(0.0942)	(0.0932)	(0.1213)	(0.1377)
GDP growth$_{it}$	0.1007	0.0900	0.0275	0.0172	-0.0583	0.3532
	(0.1320)	(0.1327)	(0.1435)	(0.1454)	(0.2568)	(0.9110)
Constant	0.6136 ***	0.6277 ***	0.6950 ***	0.7109 ***	0.2697 ***	0.2853 ***
	(0.0269)	(0.0288)	(0.0270)	(0.0303)	(0.0574)	(0.1001)
Number of observations	1,375	1,375	1,172	1,172	1,061	1,061
R^2 within	0.4435	0.4425	0.4342	0.4332		
Arellano-Bond test for AR(1) in first differences [p-value]					-4.55 [0.000]	-4.37 [0.000]
Arellano-Bond test for AR(2) in first differences [p-value]					-0.23 [0.818]	-0.11 [0.915]
Hansen test of overid. restrictions [p-value]					85.71 [0.209]	55.30 [0.281]

* p<0.10, ** p<0.05, *** p<0.01.

Note: All estimations include time effects (not reported). The Hausman test assesses the appropriateness of the random-effects specification against the fixed-effects specification.

one, respectively. Therefore, a higher value of this index would imply greater strength, that is, the bank faces lower multimarket contact intensity. The first column shows that the *IMMC* does not have a significant coefficient. In the second column, we test a possible non-linear relationship between the intensity of multimarket contact and the Lerner index using a quadratic term of the intensity of the multimarket contact measure in the regression. The *IMMC* shows a non-linear relationship as the *IMMC* coefficient and its squared are statistically significant. Therefore, the relationship is U-shaped, which indicates that market power decreases until it reaches a certain level of *IMMC*, after which it starts to increase. The minimum point of the U-shaped relationship between multimarket contacts and market power is 3.96. That is, market power decreases to levels of *IMMC* below 3.96 and begins to increase from this value. The value of the calculated minimum is found between the 95th and the 96th percentile of the distribution of the variable. This implies that the vast majority of the banks in the sample are in the decreasing stretch of the curve, which allows us to assume a negative relationship between market power and the intensity of the multimarket contacts. The few banks that are in the rising section of the curve are, for the most part, single-market banks, which dominate in the number of branches in that market.

Therefore, according to these results, *IMMC* negatively affects market power for most observations in the sample, suggesting that lower values of this variable (greater intensity of multimarket contact) may lead to higher bank market power. This result supports the hypothesis of tacit collusion among banks. Since the higher the value of the *IMMC* variable, the lower the market power, *dominant-fringe* behavior can be confirmed, in which the dominant banks defend their

position in the market through greater competition, whereas fringe banks only adapt their behavior to that of the dominant banks by colluding.[30]

The results also show that the relationship between bank market power and the concentration index are positive and significant, suggesting that banks compete less intensely in markets where concentration is high. As the coefficient of the efficiency is negative and statistically significant, the *efficient structure hypothesis* is confirmed. Finally, the most highly capitalized banks enjoy greater market power.

The results when the potential endogeneity variables are instrumented are reported in the third and fourth columns and are practically the same as in the previous regressions, except market concentration, which loses its significance in the first case; liquid reserves, which now have a statistically significant coefficient; and the loans to total assets ratio, which has a significant coefficient in the first case, with a negative effect on market power. The two-step generalized method of moments (GMM) regression results can be seen in the fifth and sixth columns of Table 4.4 and are essentially the same as in the previous regressions.

In some of the empirical literature that analyzes multimarket contacts (Coccorese and Pellecchia, 2009; Kasman and Kasman,

[30] Repeating the regression, but substituting the *IMMC* variable for a dummy variable that takes value one for the dominant banks (with an *IMMC* value above 1), a negative and significant coefficient is obtained for this variable. However, when the regression is performed with the dummy variable taking a value of one for the fringe banks (with an *IMMC2* equal to or below 1), a positive and significant coefficient is obtained. These results confirm that the dominant banks defend their position in the market through competitive behavior, while the fringe banks could simply follow the behavior of the dominant banks.

2016, among others), robustness tests are carried out considering only those banks that operate in more than one market, literally "multimarket" banks. Therefore, following the previous literature, only the subset of banks that operate in more than one market is used to test the robustness of the results using the two-step GMM methodology. Banks that are only present in one market, that is, they cannot be considered as "multimarket" banks, represent 38.55% in 2006 and 53.97% in 2017. Table 4.5 shows the results using only the multimarket banks, again displaying the negative and quadratic relationship for the multimarket contact indicator and the Lerner index of market power, as well as for the intensity of multimarket contact indicator and market power. These results are in line with those obtained in the previous regressions. The rest of the results remain practically unaltered, as the more efficient and more highly capitalized banks are those that enjoy greater market power. The robustness of the results is therefore confirmed.

4.5.2. Economic impact

To quantify the economic impact of each variable on the Lerner index we consider the change, in percentage points, in the Lerner index associated with an interquartile variation of each of these explanatory variables, that is, a change from percentile 25 to 75 of the distribution or, what is the same, the difference in market power between a bank that is in the 25^{th} percentile of the distribution and another in the 75^{th} percentile of each of the explanatory variables. Taking the estimated parameters in column 6 of Tables 4.3 and 4.4, Figure 4.4 ranks the variables from the largest to the smallest impact.

Table 4.5. Determinants of Lerner index: 2006-2017. Multimarket banks.

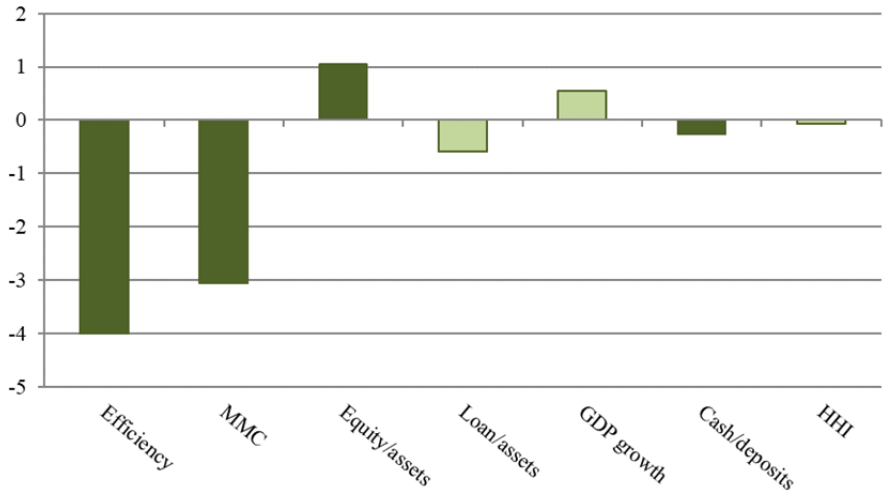
Dependent variable: Lerner index$_{it}$								
	Two-step GMM							
	[1]		**[2]**		**[3]**		**[4]**	
Lerner index$_{i(t-1)}$	0.4952	***	0.4793	***	0.5079	***	0.4359	***
	(0.0989)		(0.1009)		(0.0750)		(0.0672)	
MMC$_{it}$	-0.0009	***	-0.0021	***				
	(0.0003)		(0.0006)					
MMC$^2_{it}$			0.0000	***				
			(0.0000)					
IMMC$_{it}$					-0.0396	***	-0.0375	**
					(0.0125)		(0.0166)	
IMMC$^2_{it}$							0.0057	*
							(0.0032)	
Market concentration (HHI)$_{it}$	-0.1111		-0.1219		0.0155		-0.0607	
	(0.1046)		(0.1012)		(0.0795)		(0.0692)	
Cash/deposits$_{it}$	-0.0660		-0.1013		-0.0575		-0.1038	
	(0.1360)		(0.1398)		(0.0940)		(0.1009)	
Efficiency$_{it}$	-0.2001	***	-0.2004	***	-0.1863	***	-0.1965	***
	(0.0364)		(0.0340)		(0.0286)		(0.0256)	
Loan/assets$_{it}$	0.0005		0.0199		0.0085		-0.0066	
	(0.0256)		(0.0253)		(0.0213)		(0.0238)	
Equity/assets$_{it}$	0.3630	**	0.2438		0.3991	**	0.5214	***
	(0.1835)		(0.1563)		(0.1540)		(0.1568)	
GDP growth$_{it}$	0.2320		0.2610		-0.1272		-0.0229	
	(0.3342)		(0.3518)		(0.4615)		(0.4604)	
Constant	0.3326	***	0.3517	***	0.3423	***	0.3809	***
	(0.1036)		(0.1011)		(0.0914)		(0.0790)	
Number of observations	814		814		805		805	
Arellano-Bond test for AR(1) in first differences [p-value]	-3.95 [0.000]		-3.83 [0.000]		-3.94 [0.000]		-3.84 [0.000]	
Arellano-Bond test for AR(2) in first differences [p-value]	-0.08 [0.940]		-0.09 [0.929]		-0.14 [0.885]		-0.23 [0.816]	
Hansen test of overid. Restrictions [p-value]	44.44 [0.453]		43.08 [0.511]		79.25 [0.377]		89.12 [0.359]	

* p<0.10, ** p<0.05, *** p<0.01.

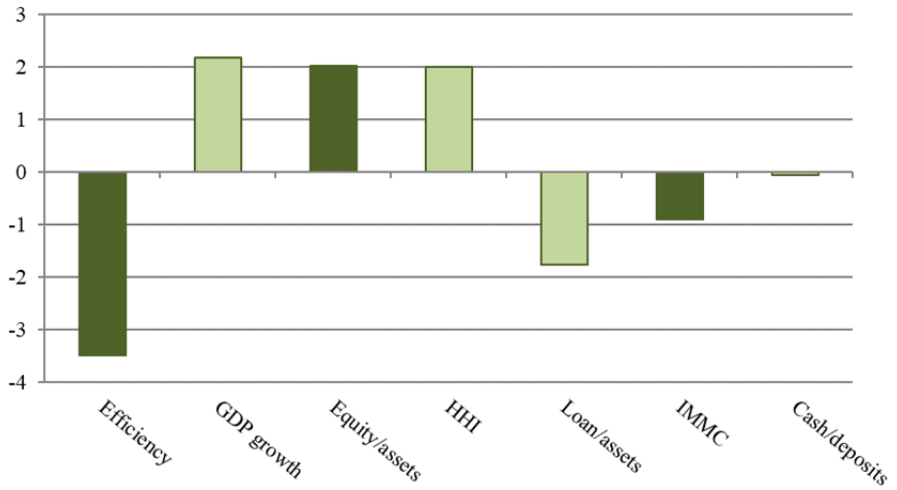
Note: All estimations include time effects (not reported).

Figure 4.4. Economic impact of the Lerner index determinants. Percentage points.

a) MMC



b) IMMC



Note: The figure shows the effect on the Lerner index of a variation in each of the explanatory variables from the value of the bank located in the percentile 25th to 75th or, what is the same, the difference in market power between a bank that is in the 25th percentile of the distribution and another that is in the 75th percentile of each of the explanatory variables. The faint colored bars in the figure correspond to variables with no statistically significant effect. The variables are ordered from the highest to lowest relevance.

Figure 4.4 (a) displays the economic impact of each explanatory variable on the Lerner index, when the multimarket contact variable (*MMC*) is used, showing that the largest effect is that of efficiency. Specifically, the difference in market power between a bank with an efficiency level in the 25th percentile of the distribution and another with a level in the 75th percentile is 4.00 pp. The second variable with the greatest economic impact on the Lerner index is the *MMC* variable, with a difference in market power of 3.06 pp between a bank with an *MMC* level in the 25th percentile of the distribution and another with a level in the 75th percentile. The third variable with the greatest economic impact on the Lerner index is the equity/assets ratio, with a difference of 1.05 pp between a bank with a level of this ratio in the 25th percentile of the distribution and another with a level in the 75th percentile. Finally, the cash to deposits ratio also has an impact on the Lerner index, although it is smaller than in the previous cases, with a difference of 0.26 pp between a bank with a cash to deposits ratio level in the 25th percentile of the distribution and another with a level in the 75th percentile of the distribution.

Figure 4.4 (b) shows the economic impact of each variable on the Lerner index when the intensity of multimarket contact variable (*IMMC*) is used. The largest effect is also that of efficiency. The difference in market power between a bank with an efficiency level in the 25th percentile of the distribution and another with a level in the 75th percentile is 3.49 pp. The second variable with the greatest economic impact on the Lerner index is the equity/assets ratio, with a difference in market power of 2.02 pp between a bank with this ratio in the 25th percentile of the distribution and another with a level in the 75th percentile. The variable that proxies the intensity of multimarket

contact has the third biggest effect on the Lerner index, with a difference of 0.90 pp between a bank with an IMMC level in the 25th percentile of the distribution and another with a level in the 75th percentile.

These results confirm the importance of both the multimarket contact variable and the intensity of the multimarket contact variable as determinants of the Lerner index. Efficiency and the ratio of capitalization are also confirmed as important determinants of market power.

Table 4.6. Observed changes in the explanatory variables and predicted changes in market power. Percentage points.

	MMC	IMMC	HHI	Cash/ deposits	Efficiency	Loan/ assets	Equity/ assets	GDP growth
Change 2006-2017	-1.06	-0.28	0.05	6.23	9.67	-12.53	3.36	-4.93
Predicted change in Lerner index	0.24	0.07	-0.01	-1.02	-1.82	0.26	0.75	-0.44

If now, instead of assuming a variation equivalent to the interquartile range, we use the variations of the mean of each of the explanatory variables from 2006 to 2017, as shown in Table 4.6, the evolution of the statistically significant variable that most affected the Lerner index is again the efficiency. The decrease in efficiency in Spanish banks (the cost to income ratio increases) in this period caused a decrease of 1.82 pp in the Lerner index. The second statistically significant variable whose evolution had a greater impact on the Lerner index is the cash to deposits ratio. The increase in liquid reserves during the period analyzed led to a fall in the Lerner index of 1.02 pp. The third statistically significant variable whose evolution had the greatest impact on the Lerner index is the equity to total assets

ratio. The increase of the ratio of capitalization had a positive effect of 0.75 pp in the Lerner index. Finally, the evolution of the variables of interest *MMC* and *IMMC* have an impact of 0.24 pp and 0.07 pp on the Lerner index, respectively. These variations are much more modest than those we found under the assumption of market power difference between a bank with a value of *MMC* and *IMMC* in the 25th percentile and another with a value in the 75th percentile. This is because the variation of the average multimarket contact index was much smaller than the interquartile variation.

4.6. Conclusions and Policy Implications

This chapter's analysis of the determinants of Lerner index for the Spanish banking sector during the period 2006-2017 provides new information on competitive dynamics. In particular, we investigated the effect of multimarket contacts, together with their intensity. With this objective, the measure of multimarket contact proposed by Coccorese and Pellecchia (2009) is used, as well as a new indicator that captures the intensity of the multimarket contacts. The main results indicate that multimarket contacts have a negative effect on market power. In fact, an increase in the variable that approximates the number of multimarket contacts, equivalent to moving from the 25th percentile to the 75th percentile of its distribution, would imply a decrease in the market power of a Spanish bank of 3.06 pp. This does not support the idea that multimarket contacts promote the tacit collusion in the Spanish banking industry. However, when the intensity of the multimarket contact measure is used, the results show

that a higher intensity of multimarket contacts (lower value of the *IMMC* index) encourages banks to act less strategically by colluding. In fact, an increase in the variable that approximates the intensity of multimarket contacts, equivalent to moving from the 25th percentile to the 75th percentile of its distribution, would imply a decrease in market power of 0.90 pp. However, when observing the variation in the mean of the explanatory variables during the analyzed period, a fall in the number of multimarket contacts and their intensity is observed. These decreases were due to the restructuring that took place after the financial crisis in the Spanish banking sector, with the consequent closure of branches. Now, on average, the banks coincide in a smaller number of markets and, when they do, the intensity of the contact is greater. The predicted impact of these events on the Lerner index is an increase of 0.24 pp and 0.07 pp, respectively.

A possible non-linear relationship between multimarket contact and bank market power is also examined, as well as between the different measures of the intensity of these contacts and bank market power. In the case of multimarket contact, the empirical results suggest a U-shaped relationship. That is, market power decreases until it reaches a certain level of *MMC*, after which it starts to increase. The same occurs in the case of the intensity of multimarket contacts. It should be noted that although the relationship between market power and both the number of multimarket contacts and their intensity is U-shaped, only a minority of banks is in the increasing section of the curves.

Therefore, our main results suggest the following. On the one hand, the assumption that having a greater number of multimarket contacts encourages banks to collude, increasing their market power,

is rejected. However, on the other hand, if not only the number of multimarket contacts but also their intensity is considered, it is observed that when banks face a greater intensity of multimarket contacts, they are willing to collaborate with each other, providing evidence of tacit collusion in the Spanish banking sector and accepting the assumption that mutual forbearance affects market conditions through greater intensity of multimarket contacts. In addition, this result confirms the existence of a *dominant-fringe* equilibrium in the Spanish banking sector.

Considering all the above points, from a policy point of view the mergers and acquisitions, with the consequent closing of branches (40.34% of branches have closed in Spain since 2008), have led to reduced competition, due in part to the decline in geographical overlap of the branch networks and the associated less frequent multimarket contacts among banks, as well as the increase in the intensity of these contacts. If these effects continue, particularly in view of the forthcoming wave of M&A in Europe, and are not offset by other procompetitive factors, they could continue to cause less favorable market conditions, and hence welfare losses, in the Spanish banking sector.

Appendix 4.A. A numerical example of the calculation of the intensity of multimarket contact

In order to get *IMMC*, we follow the numerical example of Coccorese and Pellecchia (2009). Let's suppose a country that is formed by three markets (A, B, C), in which 4 banks operate (1, 2, 3, 4). For a given year, the matrix **D** describes the geographical distribution of banks' branches:

$$\mathbf{D} = \begin{bmatrix} 3 & 2 & 2 \\ 0 & 1 & 3 \\ 4 & 0 & 0 \\ 5 & 2 & 1 \end{bmatrix}_{4x3} .$$

Note that rows refer to banks and columns refer to markets. Therefore, the element d_{23}=3 indicates that bank 2 has 3 branches in market C. We build the following zero-one matrix **C**, which indicates where the banks are located, regardless of the number of branches that they have:

$$\mathbf{C} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}_{4x3} .$$

The values in row 1 show that bank 1 operates in all markets. The same happens in the row 4 with bank 4. However, row 2 indicates that bank 2 operates in markets B and C, but not in market A; and row 3 indicates that bank 3 only operates in market A (bank 3 is a single-market bank).

In order to get *IMMC*, for each pair of banks, the following index is calculated:

$$m'_{11} = \left(\frac{3}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)+\left(\frac{2}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)+\left(\frac{2}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)=1$$

$$m'_{12} = 0+\left(\frac{2}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot0+2\cdot1\cdot1+2\cdot1\cdot1}\right)+\left(\frac{2}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot0+2\cdot1\cdot1+2\cdot1\cdot1}\right)=1.33$$

$$m'_{13} = \left(\frac{3}{4}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{3\cdot1\cdot1+2\cdot1\cdot0+2\cdot1\cdot0}\right)+0+0=0.75$$

$$m'_{14} = \left(\frac{3}{5}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)+\left(\frac{2}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)+\left(\frac{2}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{3\cdot1\cdot1+2\cdot1\cdot1+2\cdot1\cdot1}\right)=1.11$$

$$m'_{21} = 0+\left(\frac{1}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{0\cdot0\cdot1+1\cdot1\cdot1+3\cdot1\cdot1}\right)+\left(\frac{3}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{0\cdot0\cdot1+1\cdot1\cdot1+3\cdot1\cdot1}\right)=1.25$$

$$m'_{22} = 0+\left(\frac{1}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{0\cdot0\cdot0+1\cdot1\cdot1+3\cdot1\cdot1}\right)+\left(\frac{3}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{0\cdot0\cdot0+1\cdot1\cdot1+3\cdot1\cdot1}\right)=1$$

$$m'_{23} = 0+0+0=0$$

$$m'_{24} = 0+\left(\frac{1}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{0\cdot0\cdot1+1\cdot1\cdot1+3\cdot1\cdot1}\right)+\left(\frac{3}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{3}{0\cdot0\cdot1+1\cdot1\cdot1+3\cdot1\cdot1}\right)=2.37$$

$$m'_{31} = \left(\frac{4}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{4}{4\cdot1\cdot1+0\cdot0\cdot1+0\cdot0\cdot1}\right)+0+0=1.33$$

$$m'_{32} = 0+0+0=0$$

$$m'_{33} = \left(\frac{4}{4}\cdot 1\cdot 1\right)\cdot\left(\frac{4}{4\cdot1\cdot1+0\cdot0\cdot0+0\cdot0\cdot0}\right)+0+0=1$$

$$m'_{34} = \left(\frac{4}{5}\cdot 1\cdot 1\right)\cdot\left(\frac{4}{4\cdot1\cdot1+0\cdot0\cdot1+0\cdot0\cdot1}\right)+0+0=0.80$$

$$m'_{41} = \left(\frac{5}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{5}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)+\left(\frac{2}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)+\left(\frac{1}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)=1.35$$

$$m'_{42} = 0+\left(\frac{2}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{5\cdot1\cdot0+2\cdot1\cdot1+1\cdot1\cdot1}\right)+\left(\frac{1}{3}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{5\cdot1\cdot0+2\cdot1\cdot1+1\cdot1\cdot1}\right)=1.44$$

$$m'_{43} = \left(\frac{5}{4}\cdot 1\cdot 1\right)\cdot\left(\frac{5}{5\cdot1\cdot1+2\cdot1\cdot0+1\cdot1\cdot0}\right)+0+0=1.25$$

$$m'_{44} = \left(\frac{5}{5}\cdot 1\cdot 1\right)\cdot\left(\frac{5}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)+\left(\frac{2}{2}\cdot 1\cdot 1\right)\cdot\left(\frac{2}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)+\left(\frac{1}{1}\cdot 1\cdot 1\right)\cdot\left(\frac{1}{5\cdot1\cdot1+2\cdot1\cdot1+1\cdot1\cdot1}\right)=1$$

Therefore, the matrix $\mathbf{M}'$comes out to be:

$$\mathbf{M}' = \begin{bmatrix} 1 & 1.33 & 0.75 & 1.11 \\ 1.25 & 1 & 0 & 2.37 \\ 1.33 & 0 & 1 & 0.80 \\ 1.35 & 1.44 & 1.25 & 1 \end{bmatrix}_{4x4},$$

where the strictly positive off-diagonal elements show the number of branches of the bank in relation with the number of rivals' branches on average (weighted by the branch network) in a market when they meet. Taking row 4 as an example, bank 4 has on average in a market 35% more branches than bank 1 (m'_{41}=1.35), it has 44% more branches than bank 2 (m'_{42}=1.44) and 25% more branches than bank 3 (m'_{43}=1.25). The diagonal elements are always one as it is logic.

After that, we calculated the matrix **P:**

$$\mathbf{P} = \begin{bmatrix} 0 & 4 & 4 & 8 \\ 4 & 0 & 0 & 3 \\ 3 & 0 & 0 & 5 \\ 7 & 4 & 4 & 0 \end{bmatrix}_{4x4},$$

where the diagonal elements are zero, while the strictly positive off-diagonal elements show the number of branches of the rivals when they coincide with each bank. Taking row 4 as an example, bank 1 has 7 branches in all markets where it coincides with bank 4 (p_{41}=7), bank 2 has 4 branches in all markets where it coincides with bank 4 (p_{42}=4) and bank 3 has 4 branches in all markets where it coincides with bank 4 (p_{43}=4).

And then, we calculated the matrix **P'**:

$$\mathbf{P}' = \begin{bmatrix} 0 & 4/8 & 4/8 & 8/16 \\ 4/14 & 0 & 0 & 3/16 \\ 3/14 & 0 & 0 & 5/16 \\ 7/14 & 4/8 & 4/8 & 0 \end{bmatrix}_{4x4},$$

where each element of the matrix **P** is divided by the sum of each column of the same matrix.

And the matrix **F** is calculated as follows:

$$\mathbf{F} = \mathbf{M}' \cdot \mathbf{P}' = \begin{bmatrix} 1.10 & 1.06 & 1.06 & 0.98 \\ 1.47 & 1.81 & 1.81 & 0.81 \\ 0.61 & 1.06 & 1.06 & 0.98 \\ 1.18 & 1.18 & 1.18 & 1.34 \end{bmatrix}_{4x4}.$$

The average intensity of the multimarket contacts index (*IMMC*) for each bank is the corresponding element of the diagonal:

$$IMMC_1 = 1.10$$
$$IMMC_2 = 1.81$$
$$IMMC_3 = 1.06$$
$$IMMC_4 = 1.34$$

CHAPTER 5

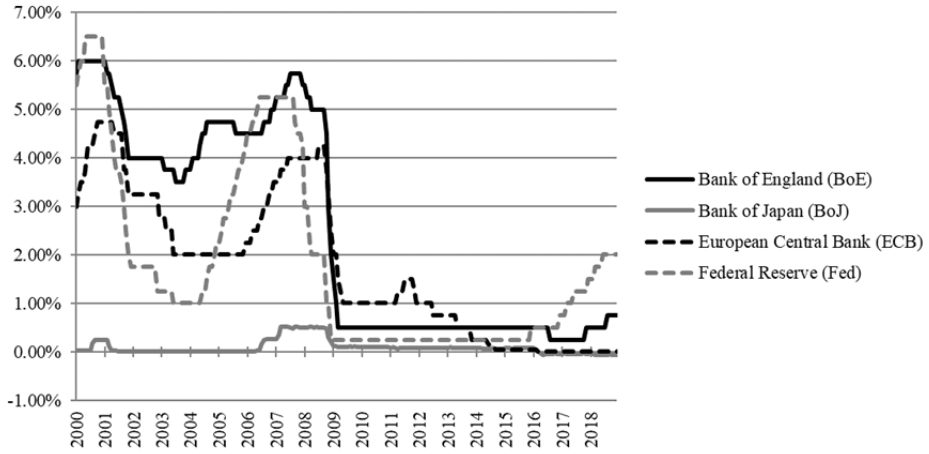
The Impact of Monetary Policy on Bank Profitability: How Does it Affect?

5. The Impact of Monetary Policy on Bank Profitability: How Does it Affect?

5.1. Introduction

The accommodative monetary policy, carried out by the main central banks in order to combat the effects of the financial crisis that erupted in 2008, has led to an extended period of low – or even negative – interest rates. In late 2008 and early 2009 policy rates fell sharply, reaching thereafter values very close to the lower limit of 0% as can be seen in Figure 5.1. The potential side effects of this situation of low interest rates on bank profitability has been a topic of concern in recent years. This issue is especially relevant considering that, in some cases such as the European banking sector, bank profitability is below the cost of raising capital, negatively affecting the prices of banks in the stock markets. This low profitability is due to several reasons (such as the high volume of non-performing assets, regulatory requirements, competition from *fintech* and *big tech*, etc.), outstanding the pressure of low interest rates to the net interest margin. In addition, in the case of European banks, the negative interest rate on the deposit facility is penalizing banks for excess liquidity, directly affecting their income statement and therefore profitability.

Figure 5.1. Intervention interest rates by the main Central Banks (2000-2018).



Source: Bank of England, Bank of Japan, European Central Bank and U.S. Federal Reserve.

Low interest rates maintained for an extended period may reduce banks' margins and, therefore, their profitability. With negative interest rates, the existence of an effective lower limit on the remuneration of deposits (as customers are not expected to accept a negative deposit interest rate) makes difficult to transfer the decline in interest rates to the interest on deposits and thus the financial margins narrow.

Monetary policy operates mainly affecting the short-term interest rate and the slope of the yield curve. The central banks directly control the short-term rate through the policy rate, and indirectly the yield curve through both the impact on the expectations about the future policy rate and the large-scale operations in government securities, which have an impact on their price. Very low short-term interest rates typically come hand in hand with a lower and flatter yield curve, which reduces the profit from maturity

transformation activities, reducing banks' margins and therefore their profitability.

A large part of the literature that analyzes the effect of monetary policy on bank profitability confirms a positive relationship between the level of interest rates and the profitability of banks (Weistroffer, 2013; Alessandri and Nelson, 2015 -in the long-run-; Genay and Podjasek, 2014 -only in the short-term-; Busch and Memmel, 2015 -over the medium to long-term horizon-; Aydemir and Ovenc, 2016 -in the long-run-; Sääskilahti, 2018; Borio *et al.*, 2017; Claessens *et al.*, 2018; and Cruz-García *et al.*, 2019; Angori *et al.*, 2019; among others). Nevertheless, there are some actions that banks can take to mitigate the negative impact of falling interest rates on profitability; for instance, they can reduce interest expenses (Scheiber *et al.*, 2016), increase loan spreads (Sääskilahti, 2018), set higher fees and commissions (Turk-Ariss, 2016) or decrease the importance of deposits as source of funding (International Monetary Fund (IMF), 2016). Due to the boost of the real economy as a result of low interest rates, banks would benefit from the lower provisions thanks to the improved solvency of the borrowers (Albertazzi and Gambacorta, 2009; Weistroffer, 2013; Genay and Podjasek, 2014, Borio *et al*., 2017; Altavilla *et al*., 2018; Bikker and Vervliet, 2018). However, in this context, banks can also carry out riskier lending strategies to increase their profits, which might deteriorate the quality of the bank's loan portfolio as a result of the increase in credit risk (Albertazzi *et al.*, 2018; Heider *et al.,* 2018; Demiralp *et al*., 2019). Finally, low interest rates could also positively affect the volume of

loans (Demiralp *et al.*, 2019; Rostagno *et al*., 2016), although the literature on this subject is inconclusive[31]. Thus, the net impact of decreased interest rates on bank profitability depends on how banks manage the aforementioned factors.

In this context, this chapter provides an in-depth analysis on the link between monetary policy and bank profitability. Particularly, it focuses on the effect of both the interest rate levels and the yield curve on both profitability and the banks' main source of earnings, namely net interest margin. Following Sääskilahti (2018), Borio *et al.* (2017), Bikker and Vervliet (2018), Cruz-García *et al*. (2019) and Angori *et al*. (2019), among others, the possible non-linear effect of a scenario of low interest rates on banks' profitability is also analyzed. This allows us to verify that the lower the interest rates and the flatter the yield curve, the greater the negative effect on bank profitability. A possible non-linear relationship between interest rates and net interest margin is also analyzed, as well as between the slope of the yield curve and the interest margin.

This chapter offers new empirical evidence on the impact of the current expansionary monetary policy on bank profitability, also analyzing the main channel through which it is transmitted. This analysis is carried out for 31 OECD countries over the period 2000-2017, which includes the years of economic expansion, the years of financial crisis in which aggressive monetary policy measures were

[31] Some papers find that monetary policy is less effective in stimulating credit growth when interest rates are very low (Borio and Gambacorta, 2017), and other researches even find that negative interest rates have a contracting effect on the credit supply (Heider *et al.,* 2018; Brunnermeier and Koby, 2018). The paper of Arce *et al*. (2018) suggests that there is no significant difference between the volume of credit offered by banks affected or not by negative interest.

applied and the subsequent economic recovery (characterized by the negative rates policy). The combination of years and country coverage allows us to examine countries or economic areas with different monetary policies. This guarantees enough in-sample variability so that the effects of monetary policy can be properly measured. In addition to monetary policy instruments (level of interest rates and the yield curve slope), this study considers several banks' characteristics, as well as macroeconomic variables.

The main results show that the expansionary monetary policy measures adopted in numerous economies to combat the negative effects of the crisis -with the consequent reduction in interest rates and the flattening of the yield curve- had a negative impact on net interest margins and, therefore, on bank profitability. In both cases – interest margin and profitability– the impact of interest rates is non-linear (inverted U-shaped). The same relationship is found for the slope of the yield curve. This suggests that the impact is greater the lower the interest rate and the flatter the yield curve are. Therefore, the negative effect of low interest rates on net interest margin is not offset by other factors, being negative the net effect on bank profitability. Therefore, the problem of low profitability suffered by certain banking sectors will persist as long as the current scenario of low interest rates continues, which may also affect financial stability.

After this introduction, this chapter is structured as follows: Section 5.2 provides an overview of the related literature. Section 5.3 describes the sample used and the construction of the variables for the empirical analysis. Section 5.4 summarizes the empirical findings. Finally, Section 5.5 provides some conclusions and economic policy implications.

5.2. Literature Review

In recent years, the link between monetary policy and bank profitability has gained interest as a research topic. Central banks adopted an expansionary monetary policy to cope with the financial crisis, being one of the causes of the current scenario of low bank profitability. The transmission mechanisms of the monetary policy (both interest rates and the slope of the yield curve) are as follows. On the one hand, as interest rates fell to zero and enter negative territory, financial margins narrow, and it becomes difficult to transfer the decreased interest rates to the interest on deposits. Moreover, the potential for capital gains on asset values becomes very small when there is little room for additional cuts. In addition, the bigger the proportion of loans at a floating rate, the bigger the negative impact on profitability, as the benchmark interest rate has failed more than the banks' cost of funding. Similarly, a large share of funding from deposits has a negative impact on margins when rates are very low, as it is difficult to transfer the decline in interest rates to these deposits.

A large number of works in the previous literature show a positive relationship between bank profitability and the scenario of low interest rates. Weistroffer (2013) studies for the case of Japan, the effect of the ultra-low interest rates on banks' profitability. This author finds that Japanese banks have been able to survive ultra-low interest rates for a long period, but they faced a severe decline in the net interest income and pressures to reduce costs. The loss of profitability was compensated by lending to domestic sovereign and expanding credit abroad, without assuming an excessive credit risk. Genay and Podjasek (2014) studied the effect of the interest rate level

and the slope of the yield curve on profitability for the United States, finding that a low interest rates scenario is associated with decreases in bank profitability in the short-term; although in the long term a boosted economic activity could compensate for this effect. Alessandri and Nelson (2015) find that the long-run relationship between profitability and both interest rates and the slope of the yield curve is positive for the case of the United Kingdom. However, in the short-run, increases in market rates compress interest margins due to the presence of loan pricing frictions. For the German banking system, Busch and Memmel (2015) demonstrate that banks' net interest income benefits in the long-term horizon from interest rate increases. Aydemir and Ovenc (2016) found, for the Turkish banking system during 2002-2014, that the relationship between both the short-term interest rate and the slope of the yield curve with profits is negative in the short-run, but it turns positive in the long-run. Sääskilahti (2018) analyzes the relationship between low interest rates and retail bank interest margins in the Finnish retail banking market, allowing for non-linearities and finding that the market interest rates are positively related with the net interest margins of both new operations and stock of operations.

Borio *et al*. (2017) find a positive effect of both the level of short-term interest rates and the slope of the yield curve on bank profitability for a sample of 14 advanced economies. These authors also analyze the possible non-linear relationship between the banks' profitability and both interest rates and the yield curve slope, finding that the effects on net interest margins are much stronger at lower levels of interest rates and where there is a flatter yield term structure. The effect of monetary policy on the different main components of

bank profitability is also analyzed, showing that the effect on net interest income offsets the effect on non-interest income and provisions. Claessens *et al.* (2018) obtain strong evidence on the negative impact of low interest rates and the flattening of the yield curve on net interest margin and profitability for a sample of 47 countries. Pérez and Ferrer (2018) study the effects of these two variables on bank profits and balance sheet structure in Spain during the 2000-2016 period, finding a positive non-linear relationship between interest rates and profit measures, especially the net interest income.

Arce *et al.* (2018) find, for the case of the euro area, that those banks whose net interest income is adversely affected by negative rates are lowly capitalized and take less risk. However, no differences in banks' credit supply are found. In the case of Bikker and Vervliet (2018), the authors found that low short-term interest rates compress net interest margins and reduce the levels of credit loss provisions for the United States banking sector, being the effect non-linear. The effect on net interest income offsets the effect on provisions. These results are in line with those obtained by Borio *et al.* (2017). Cruz-García *et al*. (2019) analyze, for a sample of 32 OECD countries, the impact of interest rates and the slope of the yield curve on net interest margins, finding a positive and non-linear relationship, although the effect of the flattering of the yield curve is less economically significant than that of interest rates. The same results are obtained by Angori *et al*. (2019) analyzing, for the case of the euro area, the impact of interest rates and the slope of the yield curve on net interest margins, finding a positive and non-linear relationship between them. Molyneux *et al.* (2019) investigate the influence of negative interest

rate policy (NIRP) on bank net interest margins and profitability for a dataset of banks from 33 OECD countries. These authors find that bank margins and profits fell in NIRP adopter countries compared to countries that did not adopt the policy.

Other studies find no evidence of a significant effect of the low interest rate scenario on bank profitability. English (2002) finds no evidence of the existence of an effect of interest rates or the slope of the yield curve on net interest margin for many countries (Australia, Canada, Germany, Italy, Japan, Norway, Sweden, Switzerland and United Kingdom). The exception in this paper is United States, where the slope of the yield curve affects the margin significantly and with the positive sign suggested by the conventional vision. Scheiber *et al.* (2016) analyze, for the case of Denmark, Sweden and Switzerland, the risks of side effects of the negative interest rates on bank profitability and particularly on net interest income. These authors conclude that negative interest rates have not resulted in a significant reduction of net interest income so far, since the decline in interest income have been compensated by declines in interest expenses. A similar result is found by Turk-Ariss (2016), in the case of Denmark and Sweden. Altavilla *et al.* (2018) study a panel of European banks, not finding evidence of a significant effect of interest rates on profitability when controlling for current and expected macroeconomic conditions. However, they find a positive effect of interest rates on the non-interest income and provisions. Some (few) studies have found a negative relationship between interest rates and bank profitability, such as Kohlscheen *et al.* (2018), which find that higher short-term interest rates reduce profitability by raising funding costs in 19 emerging market economies.

Some works of the related previous literature, most of it mentioned above, deal with the effects of a low interest rate environment on bank profitability just for a specific country. Weistroffer (2013) for the Japanese case, Genay and Podjasek (2014) and Bikker and Vervliet (2018) for the United States, Alessandri and Nelson (2015) for United Kingdom, Busch and Memmel (2015) and Entrop, *et al.* (2015) for Germany, Ahtik *et al*. (2016) for the case of Slovenia, Sääskilahti (2018) for Finland, Aydemir and Ovenc (2016) for Turkey, Pérez and Ferrer (2018) for Spain.

Therefore, the results of the previous literature can be mainly divided into those finding a positive relationship between the current expansionary monetary policy and bank profitability, and those finding an inconclusive effect. This confirms that the net impact of decreasing interest rates on bank profitability depends on how banks manage the rest of the factors that affect profitability such as provisions, fees and commissions, the importance of deposits such as source of funding, etc.

5.3. Data, Variables and Methodology

5.3.1. Sample and sources of information

The sample used in the empirical analysis includes banks from 31 OECD countries all over the world[32] over the period 2000-2017,

[32] Austria, Australia, Belgium, Canada, Switzerland, Colombia, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Japan, Luxembourg, Latvia, Netherlands, Norway, New Zealand, Poland, Portugal, Russian Federation, Sweden, Slovenia, Slovak Republic, United States and South Africa.

which includes the pre-crisis sub-period, the crisis sub-period and the years of the subsequent economic recovery. Therefore, the analyzed time span covers the period in which many countries implemented expansionary policy measures to cope with the financial crisis.

All banks included in BankScope and Orbis (Bureau van Dijk) databases for the aforementioned countries are considered. The financial statements used are unconsolidated (domestic business in each country), since the dependent variables depend on interest rates (short-term level and slope of the yield curve) and a proper correspondence between them becomes necessary. Consolidated statements will include both domestic and cross border activities carried out by bank subsidiaries, which will depend on the interest rate of the country of the subsidiary and not on that of the parent bank. The GDP growth is obtained from the World Bank database. Money market and government debt interest rates were from the OECD database. Banks for which there was no information on any of the explanatory variables were excluded from the sample. After filtering, the panel of data used comprised 68,004 observations.

5.3.2. Variables

To perform the empirical analysis, two alternative dependent variables are used: net interest margin (difference between revenue and financial costs) and return of assets (ROA), both of them expressed as a percentage of total assets. As determinants of the alternative dependent variables the short-term interest rate and the slope of the yield curve are included as monetary policy indicators, and the growth rate of real GDP as macroeconomic indicator. Bank

specific characteristics habitually included in the literature are also taken into account. These include market power, credit risk, bank size, banks' degree of risk aversion, operating costs, implicit payments, liquidity reserves and an efficiency indicator. Finally, an indicator of uncertainty about market conditions such as the money market interest rate volatility (interest rate risk) is also added, as well as the interaction between this risk and the credit risk.

The abovementioned variables are fully explained in the following paragraphs.

Monetary policy variables

Interest rate

Following Alessandri and Nelson (2015), Borio *et al*. (2017), Cruz-García *et al*. (2019) and Angori *et al.* (2019), among others, the three-month interbank market interest rate is used as a proxy for short-term interest rates (*Short term interest rate*). The square of the variable is introduced in the estimates to capture a possible non-linear relationship between the level of interest rates and each of the dependent variables. Given that there exists an effective lower limit on the remuneration of deposits, it is not possible to transfer the decrease in interest rates to the interest rate of the deposits and, therefore, the net interest income is reduced. Therefore, a positive relationship between the level of interest rates and net interest income is expected.

The effect of the drop-in level of interest rates on overall bank profitability will depend on whether or not the negative effect on the net interest margin is offset by other positive effects.

Slope of the yield curve

To proxy the slope of the yield curve (*Slope of the yield curve*), the difference between the interest rate on a ten-year bond and the three-month interbank market interest rate is used, following Aydemir and Ovenc (2016), Borio *et al*. (2017), Cruz-García *et al*. (2019) and Angori *et al.* (2019), among others. To capture a possible non-linear relationship between the slope of the yield curve and the alternative dependent variables, the square of the variable is included.

Analogously to the case of interest rates, the expected relationship between the slope of the yield curve and the net interest margin is positive. Once again, the effect of the slope of the yield curve in the bank's overall profitability will depend on whether or not the effect on the net interest margin is offset by other contrary effects.

Bank-specific variables

Market power

As a proxy of market power the Lerner index (*Lerner index*) is used, defined as:

$$L_{it} = \frac{(P_{it} - MC_{it})}{P_{it}} \tag{5.1}$$

where P_{it} is the average price of the output of bank i in year t and MC_{it} is the marginal cost. To calculate the Lerner index, the price of banking output (proxied by total assets) is measured as the ratio between total income and total assets.

Given that the traditional approximation of the Lerner index has the limitation that it disregards the risk faced by banks, following Cruz-Garcia *et al.* (2018), the marginal cost is calculated based on the following translog cost function corrected by credit risk:

$$lnC_{it} = \alpha_0 + \alpha_1 lnTA_{it} + \frac{1}{2}\alpha_k (lnTA_{it})^2 + \sum_{j=1}^{4} \beta_j lnw_{jit} + \frac{1}{2}\sum_{j=1}^{4}\sum_{k=1}^{4} \beta_{jk} lnw_{jit} lnw_{kit} + \frac{1}{2}\sum_{j=1}^{4} \gamma_j lnTA_{it} lnw_{jit} + \mu_1 Trend + \frac{1}{2}\mu_2 Trend^2 + \mu_3 Trend\ lnTA_{it} + \sum_{j=1}^{4} \delta_j Trend\ lnw_{jit} + v_i + u_{it} \quad (5.2)$$

where *C* stands for the total costs (financial costs, operating costs and provisions (as an ex-post approximation of the cost of risk)), *TA* is total assets, *Trend* reflects the effect of technological change (which translates into displacements of the cost function over time), v_i are the fixed effects and u_{it} is a random disturbance. Lastly, *w* is the price of the production factors, which are measured as follows:

w_1: Price of labor = staff costs / total assets[33].
w_2: Price of lendable funds = financial costs / lendable funds.
w_3: Price of capital = operating costs (except staff costs) / fixed assets.
w_4: Price of credit risk = financial asset impairment losses/ volume of lending.

[33] As there are no data in the databases used on the number of employees for the entire sample, the ratio of staff cost to total assets as a proxy for the price of labor has been used.

As it is common practice, Equation (5.2) is estimated imposing conditions of symmetry and grade one homogeneity in input prices.[34]

The expected effect of the Lerner index on the net interest margin is positive, given that banks with more market power can establish wider margins. Therefore, as a consequence, the expected effect of the Lerner index on profitability will also be positive.

Credit risk

Following Maudos and Fernández de Guevara (2004), Entrop *et al.* (2015), Altavilla *et al.* (2018), Cruz-García *et al.* (2019), among others, the credit risk is included as an explanatory variable. However, considering that a direct measure of the variation in the return on the lending portfolio associated with the risk of non-payment is unfortunately not available in the sources of data used, credit risk is approximated by the ratio between provisions for insolvencies and the net volume of credit granted, as it is to be assumed that the higher the default rate, the larger the provisions banks set.

The expected effect of credit risk on net interest margin is positive because banks charge an implicit risk premium in those operations with a higher default risk. The expected effect of credit risk on profitability will be also positive since riskier operations are usually the most profitable too.

[34] Note that the cost function differs from the traditional one in the fact that it includes, in addition to the financial and operational costs, the provisions that a bank makes each year, being this variable a proxy ex-post of the cost of risk. Given that the cost is included in the dependent variable, it has been necessary to include the unit cost of this productive input that we can call "risk" as a determinant, approximating as a ratio between financial asset impairment losses and the volume of lending.

Bank size

Following Mamatzakis and Bermpei (2016), Borio *et al.* (2017), Cruz-García, *et al.* (2019) and Angori *et al.* (2019), among others, the bank size (*Size*), proxied by the logarithm of total assets, has been included. The expected effect of bank size on bank performance depends on whether or not economies of scope and scale take place.

Degree of risk aversion

Banks' degree of risk aversion (Risk aversion) is approximated by the ratio equity/total assets, following McShane and Sharpe (1985), Maudos and Fernández de Guevara (2004) and Cruz-García *et al.* (2019), among others.[35]

A positive relationship is expected between the degree of risk aversion and the interest margin, as banks that are more risk averse will set higher margins. The expected effect on profitability could be potentially positive or negative. The less risky operations carried out by the most risk-averse banks result in a lower profitability, since these operations also are the less profitable. However, the lower need for provisions associated with less risky operations could have a positive effect on profitability.

Operating expenses

The operating expenses are proxied by the ratio of total operating costs (overheads, not including financial costs) to total assets,

[35] Note that this ratio is a measure of capitalization and presents limitations as a measure of risk aversion, since the inclusion of the minimum capital required by the regulation. However, unfortunately, there is no better proxy for this variable.

following Maudos and Fernández de Guevara (2004). Following theoretical models of the determination of the net interest margin (Maudos and Fernández de Guevara, 2004), the expected effect of the operating expenses on the net interest margin is positive since net interest margin should at least cover operating costs. Therefore, the higher the operating costs the higher the net interest margin. Since operating expenses are a direct part (identity) of profitability, they are not included as a determinant of ROA.

Implicit interest payments

Deposits interest rate not only remunerates deposits, but implicitly incorporates the remuneration (paying a lower interest rate) of a wide array of services associated with them. As an approximation of the implicit interest payment (*Interest payments*), the variable operating expenses net of non-interest revenues is used, expressed as a percentage of total assets, following Maudos and Fernández de Guevara (2004), Entrop *et al.* (2015), Cruz-García *et al.* (2019) and Angori *et al.* (2019), among others.

The implicit payments have an expected positive effect on net interest margin, since higher implicit payments imply higher operating costs, which need to be compensated by a higher margin.

Liquid reserves

Liquid reserves represent an opportunity cost as they mean that income investment of these reserves cannot be invested in profitable assets. Since liquid reserves represent an opportunity cost of not investing funds held in more profitable assets, the expected effect of

liquid reserves on profitability is negative. However, the expected effect of liquid reserves on net interest margin is positive since banks set higher margin to compensate this opportunity cost. Therefore, the net effect on profitability could also be positive if the effect on the net interest margin prevails.

This variable (*Reserves*) is approximated by the ratio between liquid reserves and total assets and it is included as an explanatory variable following Entrop *et al.* (2015), Mamatzakis and Bermpei (2016), Borio *et al.* (2017), Cruz-García *et al.* (2019) and Angori *et al.* (2019), among others.

Efficiency

To proxy the bank efficiency, the ratio cost to income ratio (ratio of operating expenses to operating income) is used. The higher this ratio, the greater the operating inefficiency. This variable is included by other authors as Borio *et al.* (2017), Cruz-García *et al.* (2019) and Angori *et al.* (2019), among others.

The expected effect of the efficiency ratio on the net interest margin and profits is negative, since this variable is inversely proportional to management efficiency and better managed banks enjoy greater margin.

Market variables

Interest rate risk

Higher interest rate risk will imply that banks charge a higher implicit risk premium, so an indicator of the interest rate risk is included as determinant of the net interest income and of profitability.

The expected relationship between the interest rate risk and the interest margin is positive. The net effect of interest rate risk on bank profitability will depend on whether the effect on the margin or the other effects prevails.

Money market uncertainty is usually captured through the volatility of a representative interest rate. The coefficient of variation calculated with monthly data on the three-month inter-bank rate (*Interest rate risk*) is used to proxy the interest rate risk as in Borio *et al.* (2017), Cruz-García *et al.* (2019) and Angori *et al.* (2019), among others. As it is habitual in the literature of the determination of the net interest margin (see Angbazo, 1997 or Maudos and Fernández de Guevara, 2014), the interaction between credit risk and interest rate risk (*Risk interaction*) is included, proxied by the product of the measurement of credit risk and money market risk.

GDP growth

Finally, as it is common practice in the literature, the annual rate of GDP growth (*GDP growth*) is included in order to control for the possible influence of the economic cycle.

Table 5.1 contains the average values of the variables used, and the number of observations per country. In the case of the net interest margin, the average ranges between a maximum value of 5.53% (Colombia) and a minimum value of 1.01% (Luxembourg). And for the case of the bank profitability, the average varies between a maximum value of 2.75% (Iceland) and a minimum value of 0.29% (Japan). Regarding the monetary policy variables, that are the focus of this chapter, the short-term interest rate varies between a maximum value of 8.79% (Russian Federation) and a minimum value of 0.29%

Table 5.1. Descriptive statistics (averages).

	Net interest margin/ total assets (%)	ROA (profit before taxes) (%)	Short-term interest rate (%)	Slope of the yield curve (%)	Lerner index	Credit risk (%)	Volatility of market interest rates	Size
Austria	2.04	0.55	1.75	1.24	0.19	0.68	13.14	12.99
Australia	2.07	0.80	3.76	0.41	0.20	0.20	7.18	15.16
Belgium	2.02	0.90	2.10	1.46	0.22	0.46	12.86	15.45
Canada	2.02	0.76	2.24	1.19	0.22	0.25	10.27	14.95
Switzerland	1.37	0.59	0.74	1.17	0.22	0.44	24.32	13.35
Colombia	5.53	2.28	5.75	3.35	0.29	2.12	7.83	13.91
Czech Rep.	2.12	1.14	1.72	1.41	0.31	0.65	11.05	15.17
Germany	2.40	0.50	2.25	0.99	0.16	1.31	12.44	13.35
Denmark	3.62	1.22	2.31	1.02	0.26	1.26	13.42	12.89
Spain	2.13	0.74	2.21	1.89	0.23	0.93	12.22	14.52
Finland	1.35	0.71	0.46	1.10	0.30	0.15	23.91	13.50
France	2.16	0.96	2.15	1.31	0.23	0.61	12.56	15.33
UK	1.79	0.70	2.58	0.92	0.21	0.52	9.30	14.13
Greece	2.33	0.87	2.59	3.38	0.22	0.89	11.97	15.26
Ireland	1.18	1.18	2.46	2.17	0.30	0.77	11.38	15.70
Iceland	3.47	2.75	8.53	-0.78	0.28	1.97	9.96	12.34
Italy	2.62	0.80	2.17	2.04	0.20	0.86	13.36	13.18
Japan	1.50	0.29	0.29	0.69	0.20	0.36	10.34	14.90
Luxembourg	1.01	0.85	2.07	0.88	0.23	0.79	12.56	14.68
Latvia	2.34	1.15	4.00	1.18	0.31	1.69	22.25	13.32
Netherlands	1.56	0.78	2.09	1.18	0.23	0.57	12.44	15.68
Norway	2.11	1.04	2.85	0.49	0.25	0.22	10.88	13.14
New Zealand	2.41	1.02	4.04	0.74	0.22	0.25	7.18	14.58
Poland	2.85	0.99	3.76	0.82	0.23	0.95	7.98	13.49
Portugal	2.12	0.62	1.14	4.53	0.21	0.95	17.54	13.24
Russian Fed.	5.08	2.23	8.79	0.20	0.32	3.19	23.44	11.50
Sweden	2.77	1.29	1.81	1.33	0.31	0.36	14.92	12.70
Slovenia	2.22	0.69	2.26	1.81	0.21	1.20	12.83	14.16
Slovak Rep.	2.79	1.13	2.01	1.59	0.27	0.89	12.94	14.42
USA	3.21	1.29	2.33	1.56	0.30	0.52	14.16	14.58
South Africa	3.59	1.74	7.86	1.44	0.27	1.14	6.23	14.95

Table 5.1. Descriptive statistics (averages). *(cont.)*

	Risk aversion (%)	Operating costs (% total assets)	Implicit interest payments (%)	Reserves (% total assets)	Efficiency	GDP growth (%)	Number of obs.
Austria	8.29	2.05	1.07	1.50	68.41	1.68	3.061
Australia	7.68	1.85	1.15	2.29	65.30	2.67	389
Belgium	7.05	2.08	0.92	1.60	66.76	1.63	269
Canada	7.19	2.14	1.12	2.70	71.49	2.52	567
Switzerland	6.84	1.65	0.54	4.16	65.47	1.75	4.008
Colombia	16.14	4.91	1.96	6.14	58.15	4.43	332
Czech Rep.	8.31	1.70	0.65	5.14	51.62	2.60	184
Germany	6.77	2.33	1.41	2.20	70.13	1.38	21.238
Denmark	13.17	3.33	1.73	4.53	64.43	1.12	863
Spain	8.42	1.73	0.92	2.56	58.76	2.01	1.552
Finland	11.56	1.55	0.48	1.12	63.36	1.24	293
France	8.62	2.29	0.81	1.50	64.27	1.42	3.132
UK	9.78	1.61	0.85	4.36	63.92	1.71	882
Greece	11.41	2.05	0.81	2.77	59.53	1.41	146
Ireland	15.21	0.95	-0.25	3.05	30.34	5.03	55
Iceland	15.18	3.58	-0.37	5.78	54.70	3.92	66
Italy	11.05	2.41	1.39	0.97	65.63	0.34	7.313
Japan	5.58	1.20	1.03	1.66	72.60	1.15	5.000
Luxembourg	7.00	1.36	0.00	3.23	55.87	3.72	394
Latvia	10.06	2.87	0.51	9.09	61.43	4.24	152
Netherlands	7.83	1.41	0.51	5.08	55.39	1.58	85
Norway	9.90	1.52	0.92	2.57	55.93	1.49	1.233
New Zealand	10.31	1.96	1.22	3.43	59.20	2.53	139
Poland	10.54	2.80	1.29	3.23	65.23	3.75	476
Portugal	9.86	2.05	0.99	1.70	65.12	0.10	552
Russian Fed.	18.68	5.14	1.37	10.13	59.62	5.32	2.376
Sweden	13.84	2.36	1.19	0.81	59.36	2.05	1.008
Slovenia	9.06	1.95	0.77	4.24	58.21	1.75	142
Slovak Rep.	12.76	2.38	1.15	5.64	60.99	4.02	147
USA	10.12	2.77	1.57	3.44	62.88	2.07	11.743
South Africa	9.92	3.68	1.14	8.22	60.92	2.77	207

Source: BankScope, Orbis and authors' calculations.

(Japan), while in the case of the yield curve slope the variation ranges from 4.53% (Portugal) to -0.78% (Iceland). Therefore, although the interest rate does not vary across banks within a country, the sample comprises countries with a different monetary context so that there are enough variations in interest rates.

5.3.3. Methodology

The empirical approach consists of regressing each dependent variable (net interest margin, loan loss provisions and ROA) against the determinants described in the previous section. In each regression the lagged dependent variable (one-year lag) is included as explanatory variable to capture the inertia effects. The empirical estimation adopts the two-step system GMM dynamic panel estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). Both the endogeneity problem that comes from the inclusion of the lagged dependent variable as an explanatory variable and the potential endogeneity from the explanatory variables are corrected by estimating the model using the lagged variables in levels as instruments.

The consistency of the GMM estimator depends both on the assumption that the error term has no serial correlation and on the validity of the instruments used. To assess the first assumption, it is tested whether the differential error term is correlated in second-order series. By construction, the error term will have first-order serial correlation. To assess the second assumption, the Hansen test of over-identifying restrictions is used, which tests the overall validity of the instruments.

The estimation also includes time effects to reflect the impact of particular shocks in each year affecting the dependent variables. The inclusion of time dummies is especially relevant for the period of analysis of this chapter, which comprises the pre-crisis sub-period, the crisis sub-period and the years of the subsequent economic recovery.

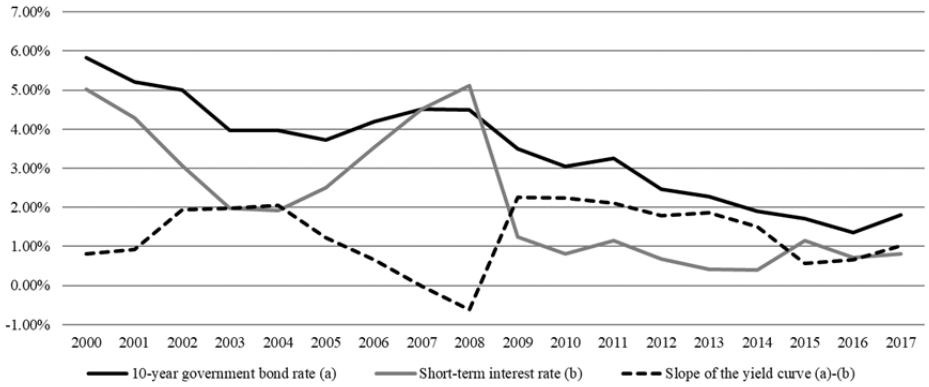
5.4. Results

Before discussing the results obtained from the regressions, the evolution of short-term interest rates and the slope of the yield curve over time for the sample of countries analyzed is examined. As Figure 5.2 shows, from 2000 to 2017, the three-month interest rate in the interbank market fell sharply in 2009 and has remained low since then, in a context of accommodative monetary policy by the main central banks. There was also a significant fall in long-term interest rates (approximated by the yield on ten-year bonds). The difference between the long- and short-term rate increased considerably in 2009 (due to plummeting short-term rates) and then gradually came down.

Figure 5.3 shows the evolution, from 2000 to 2017, of the short-term interest rate, the long-term interest rate and the slope of the yield curve for the euro area, USA, Japan, UK and the aggregation of the rest of countries in the sample.[36] There are significant differences in the level of interest rates (both in short-term interest rates and in long-term interest rates) and in the slope of the yield curve between countries/geographical regions and over time. In general, the interest

[36] Unfortunately, the interest rates of Japan between 2000 and 2002 are not available.

Figure 5.2. Interest rates and slope of the yield curve.



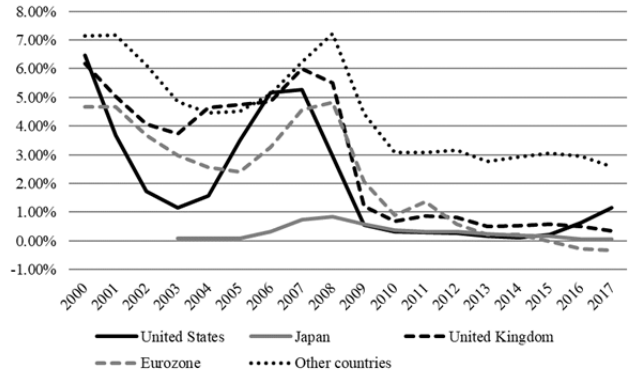
Source: OECD (2019) database and authors' calculations.

rates are much higher in other countries group, being Japan that with the lowest interest rates. Regarding the slope of the yield curve, although the level was not similar in the initial years, it has converged in United States, United Kingdom and the group of other countries in the sample. For Japan, the slope of the yield curve has slightly decreased over the whole period, while in the euro area the differential between the 10-year bond interest rate and the 3-month interbank rate increased from the outbreak of the crisis until 2012, and decreased thereafter.

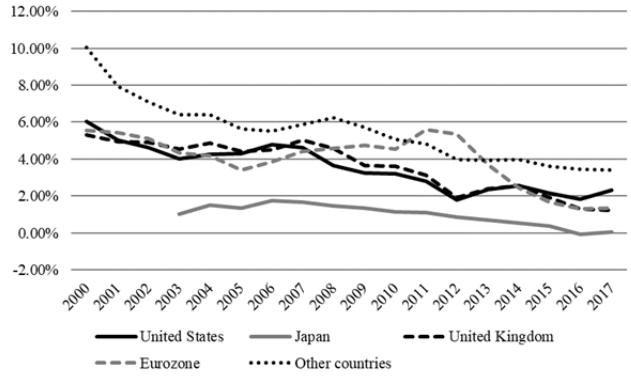
Table 5.2 shows the results of the estimations for the net interest margin and profitability (ROA). All the estimations satisfy the statistical test that rejects the second-order serial correlation, as well as the Hansen test for over-identifying restrictions. Regressions also include time effects to control for specific particular shocks in each year affecting the dependent variable. The quadratic term of the monetary policy variables is included to test for a possible non-linear

Figure 5.3. Interest rates and yield curve by countries.

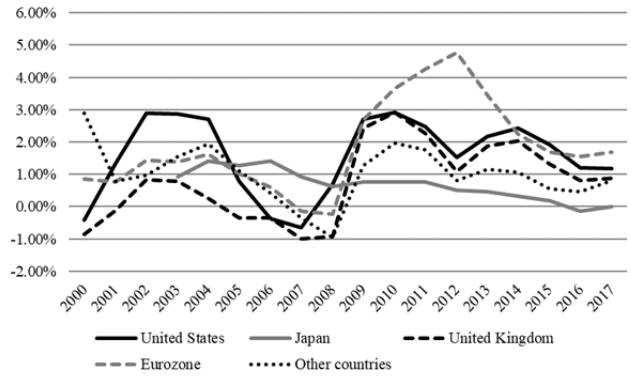
(a) 3-month interbank rates



(b) 10-year government bond rate



(c) Slope of the yield curve



Source: OECD (2019) database and authors' calculations.

Table 5.2. Results from the regressions.

	Dependent variable:			
	Net interest income to total assets$_{it}$		**ROA$_{it}$**	
Dependent variable$_{i(t-1)}$	0.1488 ***	0.2913 ***	0.2489 **	0.3067 ***
	(0.040)	(0.052)	(0.105)	(0.094)
Short-term interest rate$_{it}$	0.0778 ***	0.0768 **	0.1973 **	0.2335 ***
	(0.022)	(0.031)	(0.093)	(0.088)
Short-term interest rate$^2_{it}$	-0.5201 *	-0.2024	-1.8973 *	-0.3170
	(0.275)	(0.285)	(1.015)	(0.860)
Slope of the yield curve$_{it}$		0.0832 **		0.2670 ***
		(0.036)		(0.073)
Slope of the yield curve$^2_{it}$		-0.8064 **		-2.6798 ***
		(0.351)		(1.028)
Lerner index$_{it}$	0.0081 ***	0.0031	0.0372	0.0427 ***
	(0.003)	(0.003)	(0.029)	(0.009)
Credit risk$_{it}$	0.0084 **	0.0472	0.0404	0.0077
	(0.003)	(0.029)	(0.125)	(0.071)
Interest rate risk$_{it}$	-0.0006 ***	0.0000	-0.0003	-0.0008
	(0.000)	(0.000)	(0.003)	(0.001)
Risk interaction$_{it}$	0.0250 *	-0.0322 *	0.0780	0.0473
	(0.014)	(0.017)	(0.149)	(0.034)
Size$_{it}$	-0.0004	-0.0017 **	-0.0004	-0.0003 **
	(0.000)	(0.001)	(0.001)	(0.000)
Risk aversion$_{it}$	0.0196 *	0.0522 ***	0.0472 **	-0.0154
	(0.011)	(0.012)	(0.019)	(0.011)

relationship between these variables and each of the dependent variables.

The first two columns show the results obtained with the net interest margin as a dependent variable. In the first column, the interest rate is included as monetary policy variable. The quadratic term is also included to capture a possible non-linear effect. The total effect of the short-term interest rate on net interest margins is positive. Given that the coefficient of the squared variable is negative and

Table 5.2. Results from the regressions. *(cont.)*

	Dependent variable:			
	Net interest income to total assets$_{it}$		**ROA$_{it}$**	
Operating costs$_{it}$	0.3537 ***	0.2107 ***		
	(0.040)	(0.048)		
Implicit payments$_{it}$	0.8327 ***	0.7885 ***	-0.1103	-0.1900 **
	(0.050)	(0.073)	(0.360)	(0.083)
Reserves$_{it}$	-0.0145 **	-0.0187 **	-0.0097	-0.0308 ***
	(0.007)	(0.008)	(0.018)	(0.009)
Efficiency$_{it}$	-0.0454 ***	-0.0387 ***	0.0013	0.0107
	(0.003)	(0.003)	(0.011)	(0.007)
GDP growth$_{it}$	0.0156 ***	0.0037	0.0231	0.0241 **
	(0.006)	(0.007)	(0.030)	(0.011)
Constant	0.0325 ***	0.0440 ***	-0.0044	-0.0108 *
	(0.007)	(0.009)	(0.008)	(0.006)
Number of observations	48,858	48,858	48,858	48,858
Arellano-Bond test for AR(1) in first differences [p-value]	-2.87 [0.004]	-2.92 [0.003]	-1.66 [0.097]	-4.12 [0.000]
Arellano-Bond test for AR(2) in first differences [p-value]	-1.30 [0.193]	-0.69 [0.487]	0.48 [0.633]	1.42 [0.154]
Hansen test of overid. restrictions [p-value]	48.53 [0.051]	36.55 [0.266]	1.94 [0.857]	43.10 [0.510]

* p<0.10. ** p<0.05. *** p<0.01

Note: NIM. short-term interest rates and slope of the yield curve are in parts per unit. All estimations include time effects. Estimations are performed using the generalized method of moments (GMM) based on Arellano and Bond (1981). Arellano and Bover (1995) and Blundell and Bond (1998). where dependent variables are instrumented with their own second and third lags and other endogenous variables with their own second lag.

significant, the functional relationship follows an inverted U-shaped form, which indicates that a change in the short-term interest rate has a larger effect on the margin for lower levels of interest rates. The maximum point of this inverted U-shaped relationship is 0.075 (7.5%), which is between the 97th and the 98th percentile of the distribution of the variable. This implies that the net interest margin increases until this level of interest rate and then it starts to decrease. Regarding the other determinants of net interest margin, the results

show that banks with more market power (approximated by the Lerner index) can set a higher interest margin. Considering risk, the impact is positive and statistically significant in the case of credit risk (approximated by the ratio of provisions to total assets), such that banks exposed to higher risk charge the corresponding premium. In the case of interest rate risk (approximated by the volatility of short-term interest rates), the resulting impact is negative. More risk averse banks set a higher interest margin.

The operating expenses have a positive, statistically significant coefficient, since net interest margin should at least cover operating costs and, therefore, the higher the operating costs the higher the net interest margin. The implicit payments have also a positive and statistically significant coefficient, suggesting that banks lowering the remuneration of liabilities and charging more implicitly for their services are more likely to set higher net interest margins. The bank's liquidity is also significant, and has a negative effect. The sign implies that banks investing a larger proportion of their assets in liquid assets have more reduced interest margin. This is logical, bearing in mind the exiguous (or even zero) financial income from these assets. The results also show that better managed banks enjoy greater margin, given the negative impact of the efficiency variable. GDP growth has a statistically significant coefficient and a positive sign. The rest of the explanatory variables has non-significant coefficient. Finally, the lagged dependent variable shows a positive and significant coefficient, which confirms the high inertia in the determinants of the net interest margin.

In the second column, both the slope of the yield curve and its quadratic term are included. In this case, the quadratic term of the

interest rates loses its significance, due to the collinearity with the yield curve, while the level of interest rates maintains its positive sign. The total effect of the slope of the yield curve on the net interest margin is positive. Given that the coefficient of the squared variable is negative and significant, the relationship has an inverted U-shaped form, indicating that a change in the yield curve slope has a bigger effect on the margin the flatter it is. The maximum point in this function is 0.052 (5.2%), which is well above the values observed in the sample. From the rest of the margin determinants, the results show that those banks with larger size enjoy a smaller margin, possibly because economies of scope and scale are not taking place. The results also show that more risk averse banks set a higher interest margin. The operating expenses have a statistically significant coefficient and positive sign, as net interest margin has to cover at least the operating costs. The implicit payments also have a positive and statistically significant coefficient. The bank's liquidity is also significant, and has a negative effect. The results also show that better managed banks enjoy greater margin, given the negative impact of the efficiency variable. Finally, the lagged dependent variable shows a positive and significant coefficient, which confirms the high inertia in the trend of the net interest margins.

The last two columns show the results obtained with the return on assets as a dependent variable. The effect of the short-term interest rate on the bank profitability is again positive and non-linear (inverted U-shaped relationship), since the coefficient of the variable is positive and statistically significant and the coefficient of the quadratic term of the variable is negative and statistically significant. The maximum point of this inverted U-shaped relationship is 0.052 (5.2%), which is

between the 92th and the 93th percentile of the distribution of the variable, implying that banks are increasingly profitable until the short-term interest rate hits this maximum value, after which profitability falls. This relationship also implies that a change in the short-term interest rate has a bigger effect on profitability the lower the level of interest rates.

In the fourth column, both the slope of the yield curve and its squared term are included. In this case, again the quadratic term of the interest rates loses its significance, due to the collinearity with the slope of the yield curve, while the level of interest rates maintains its positive sign. The total effect of the slope of the yield curve on the bank profitability is positive. Given that the coefficient of the squared variable is negative and significant, the relationship has an inverted U-shaped form, indicating that a change in the yield curve slope has a bigger effect on ROA the flatter it is. The maximum point of the function is 0.05 (5%), which is above the values observed in the sample. Regarding the rest of the determinants of bank profitability, the results show that banks with more market power are more profitable. Results also show that larger banks enjoy have lower profitability, possibly, as a consequence of failed economies of scope and scale. Implicit payments have a statistically significant coefficient and a negative sign, suggesting that higher implicit interest payments imply less profitability. Since liquid reserves represent an opportunity cost of not investing funds held in more profitable assets, a larger volume of liquid reserves means lower profitability. GDP growth has a statistically significant coefficient and a positive sign. Finally, the lagged dependent variable shows a positive and significant coefficient, which confirms the inertia in the trend of the bank profitability.

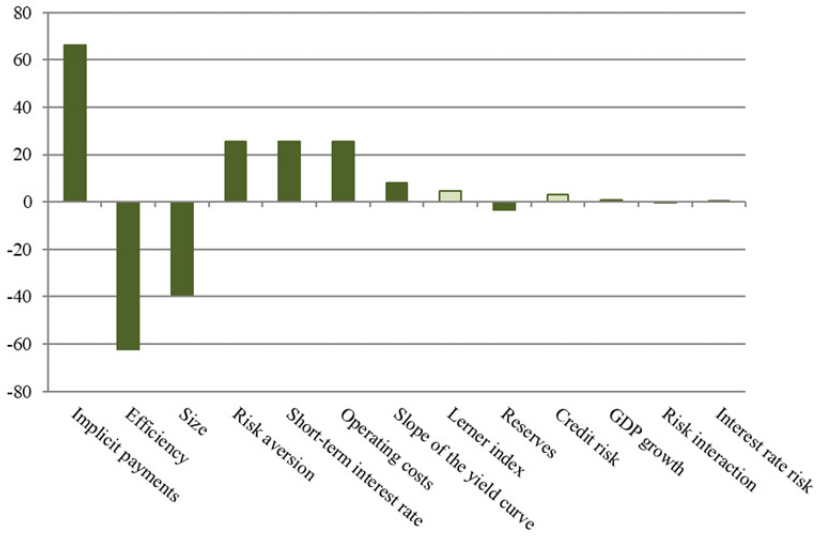
The chapter also quantifies the economic impact of each of the explanatory variables on the dependent variables. In doing so, the change (in basis points) in each dependent variable associated to an interquartile variation of the explanatory variables, i.e. a change from percentile 25th to 75th, is considered. Figure 5.4 ranks the variables from the largest to the smallest impact. For this purpose, the estimations of the second and fourth columns of Table 5.2 are used.

Figure 5.4 (a) displays the economic impact of each of the explanatory variables on the net interest margin, showing that the largest effect is that of the implicit interest payments. Specifically, the difference in net interest margin between a bank with an implicit payments level in the 25th percentile of the distribution and another with a level in the 75th percentile is 66 bp. The second variable in importance is efficiency, with a difference in net interest margin of 62 bp between two banks in the 25th and the 75th percentile, respectively. The third variable in the ranking is the bank size, for which a difference of 39 bp is associated to an interquartile variation, followed by the degree of risk aversion, which yields a 25 bp difference. The same impact is found for the short-term interest rate and the operating costs. Less meaningful are the estimated impacts for the slope of the yield curve (8 bp) and for the liquid reserves (3 bp).

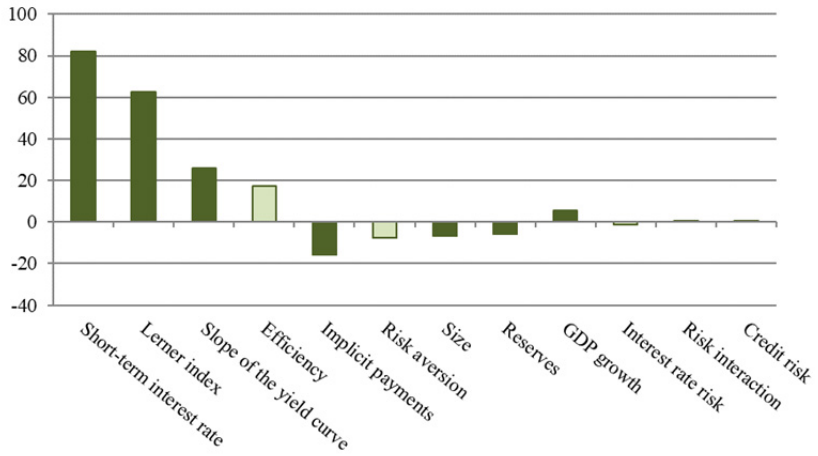
Figure 5.4 (b) shows the economic impact of each of the explanatory variables on profitability. The biggest effect is that of the short-term interest rate variable, with an 82 bp impact associated to an interquartile variation. Slightly lower is the impact for the Lerner index (62 bp). Much more limited are the impacts found for the slope

Figure 5.4. Economic impact of the Lerner index determinants. Basis points.

(a) Net interest margin



(b) ROA



Note: The figure shows the effect on each of the dependent variables of a variation in each of the explanatory variables from the value of the bank located in the percentile 25th to 75th or, what is the same, the difference in each of the dependent variables between a bank that is in the 25th percentile of the distribution and another that is in the 75th percentile of each of the explanatory variables. The faint colored bars in the figure correspond to variables with no statistically significant effect. The variables are ordered from the highest to lowest relevance.

of the yield curve, the implicit payments, size, liquid reserves and GDP growth, with an impact of 26 bp, 16 bp, 7 bp, 6 bp and 5 bp, respectively.

Table 5.3. Observed changes in interest rates and yield curve slope, and predicted changes in net interest margin and profitability (2000-2017). Basis points.

	Change in 3-month interest rate 2000-2017	Predicted change in net interest margin 2000-2017	Predicted change in ROA 2000-2017	Change in yield slope curve 2000-2017	Predicted change in net interest margin 2000-2017	Predicted change in ROA 2000-2017
Euro area	-531	-35	-115	294	31	102
USA	-530	-35	-115	160	15	50
UK	-583	-38	-125	174	17	54
Japan	-3	-0,22	-0,68	-92	-7	-22
Other countries	-571	-37	-123	-204	-14	-43

Note: The change in 3-month interest rate and the change in yield slope curve for the case of Japan is for 2003-2017 due to lack of available data.

Instead of considering interquartile variations, Table 5.3 shows the results for variations of the level of interest rates from 2000 to 2017. For this scenario, the drop in the net interest margin explained by decreased interest rates is 35 bp in the euro area, 35 bp in the USA, 38 bp in United Kingdom, 0.22 bp in Japan, and 37 bp in the group of other countries in the sample. Focusing on the drop in ROA, it is 115 bp in the euro area, 115 bp in the USA, 125 bp in the United Kingdom, 0.68 bp in Japan, and 123 bp in the group of other countries. In the case of the slope of the yield curve, the change in the net interest margin explained by changing the yield curve is 31 bp in the euro area, 15 bp in the USA, 17 bp in United Kingdom, -7 bp in Japan, and -14 bp in the group of other countries in the sample. And

the change in ROA is 102 bp in the euro area, 50 bp in the USA, 54 bp in United Kingdom, -22 bp in Japan, and -43 bp in the group of other countries.

However, as the sharp reduction in the interest rates began in 2008 in most countries in the sample, the impact of interest rates on each dependent variable over the period 2008-2017 is estimated. Table 5.4 shows that the drop in the net interest margin explained by reduced interest rates is 34 bp in the euro area, 13 bp in the USA, 34 bp in the United Kingdom, 6 bp in Japan, and 31 bp in the group of other countries in the sample. Regarding ROA, the decline amounts 112 bp in the euro area, 41 bp in the USA, 112 bp in the United Kingdom, 18 bp in Japan, and 101 bp in the group of other countries. In the case of the slope of the yield curve, the sharp drop began in 2010 in the majority of countries in our sample, not in 2008 as for the level of interest rates. Hence, its impact on the net interest margin over the period 2010 to 2017 is also estimated. The results are also reported in Table 5.4. In this case, the flattening of the yield curve translates into a drop in the net interest margin of 6 bp for euro area banks, 12 bp in the United States, 14 bp in the United Kingdom, 6 bp in Japan, and 11pb in the other countries. And the drop in ROA caused by the flattening of the yield curve is 19 bp in the euro area, 38 bp in the USA, 43 bp in United Kingdom, 19 bp in Japan, and 35 bp in the group of other countries.

In this context and, *ceteris paribus*, assuming that the interest rates recovered at 10 bp, 50 bp and 100 bp, the net interest margin would increase by 0.77 bp, 4 bp and 8 bp, respectively. Under these same assumptions, profitability would increase by 2 bp, 12 bp and 24 bp, respectively. Alternatively, *ceteris paribus*, assuming that the

slope of the yield curve recovered at 10 bp, 50 bp and 100 bp, the net interest margin would increase by 0.84 bp, 4 bp and 9 bp, respectively. Under these same assumptions, profitability would increase by 3 bp, 14 bp and 29 bp, respectively.

Table 5.4. Observed changes in interest rates and yield curve slope, and predicted changes in net interest margin and profitability (2008-2017 and 2010-2017). Basis points.

	Change in 3-month interest rate 2008-2017	Predicted change in net interest margin 2008-2017	Predicted change in ROA 2008-2017	Change in yield slope curve 2010-2017	Predicted change in net interest margin 2010-2017	Predicted change in ROA 2010-2017
Euro area	-513	-34	-112	-79	-6	-19
USA	-181	-13	-41	-172	-12	-38
UK	-515	-34	-112	-205	-14	-43
Japan	-79	-6	-18	-77	-6	-19
Other countries	-463	-31	-101	-157	-11	-35

5.5. Conclusions and Policy Implications

This chapter analyzes the changes on bank profitability and its main component, the net interest margin, due to the scenario of reduced interest rates and a flatter yield curve, both consequence of the expansionary monetary policy measures adopted by the main central banks to combat the crisis that erupted in 2008. To do so, a panel of data from 31 OECD countries covering the period 2000-2017 is used, which includes the pre-crisis, crisis and recovery sub-periods.

The results show the importance of expansionary monetary policy measures on bank's net interest margins and profitability. The relationship between the level of interest rates and bank profitability

(measured by ROA) is positive. Therefore, lower interest rates reduce profitability. This effect is mainly due to the effect that low interest rates have on the net interest margin (the main component of ROA). Lower interest rates reduce the bank's net interest margin due to the difficulty for transferring interest rates to interest on deposits, which have a lower limit close to zero. The relationship between the slope of the yield curve and both net interest margin and profitability is also positive.

The relationship between interest rates and both net interest margin and bank profitability is non-linear. Among other things, this reflects that given that the deposit rate cannot be negative, the difference between the market and the deposit rates narrows when interest rates are low, being this reduction greater the lower interest rates are. The same occurs for the case of the yield curve slope. The effect on the net interest margin and profitability is greater the more flattened the yield curve is.

In this context, the problem of low profitability that some banking sectors suffer -with profitability below the cost of capital in some countries- will persist as long as the current scenario of low interest rates remains. Low profitability could increase the likelihood that banks will assume a greater risk in order to compensate for that low profitability. In this scenario, financial stability could be compromised. Given this situation, the major challenge for those banks with low profitability is to increase efficiency by cutting costs and by finding other sources of income other than interest.

CHAPTER 6

Conclusions

6. Conclusions

Since the beginning of the financial crisis in 2008, banking markets have been subject to intense changes that have affected the profitability, margins, cost structure and banks' income sources. Therefore, as a consequence of the crisis, banks' playground has changed significantly. Regulation tightened, with greater capital requirements, new liquidity and leverage coefficients, etc., affecting banks' behavior. This scenario will continue in the coming years, due to the entry into force of the final phase of Basel III (commonly known as Basel IV). The main impact will come from the application of regulatory floor for those risk-weighted assets calculated according to the internal models, as well as new operational risk and Credit Valuation Adjustment (CVA) frameworks or the introduction of changes in the standard approach.

Changes in the banking environment have not been limited to greater (and stricter) regulation, changing the "rules of the game" established for banks, but new players have appeared. The digitalization in recent years has made the entry barriers of the financial services market to decrease remarkably, leading to new non-banking companies, the so-called *fintech* and *big tech*. The *big tech* differ from the *fintech* mainly because they have a higher amount of capital, the most advanced technology and a worldwide presence.

Regarding similarities, they have in common their 100% technological origin. The *big tech* represent a more obvious disruption, given their larger size and advantages in terms of information availability. Yet both types of companies expand the array of potential suppliers of financial products and services. One of the major concerns on this issue for many central banks is related to the lack of competition and the level of concentration associated to a greater presence of the *big tech*. Although, it can be expected that their presence in the market might increase competition, scenarios in which the consolidation of the position of dominance of the *big tech* in financial services threatens the possibility of effective competition are also feasible. The lack of a homogeneous and equal regulation for all competitors in the market further aggravates the problem. An internationally coordinated supervision and regulation activity would help to ensure a balanced competitive environment. In addition, and considering the *big tech*, they may carry systemic risks without a proper supervision, which highlights the necessity of having homogeneous rules for similar risks, regardless of the supplier.

In addition to these new technological players, the competitive conditions have also changed due to bank restructuring. In order to reduce the installed capacity, multiple mergers and acquisitions have taken place, reducing the number of banks in the market and, therefore, increasing market concentration. The concentration of banking activity in a small group of banks may be detrimental to competition. Apart from the reduction of the number of banks, the closure of branches has also modified the banks' branch network, affecting both the number and the intensity of banks contacts. Something that stands out is the absence of cross-border mergers in

Europe that would have eased the increase of concentration. This could be understood as a sign that the Banking Union is not working as it should. It is also true that the sector regulation is still too heterogeneous across countries. However, it seems that the overcapacity of the banking sector would be acting as an entry barrier for banks in other countries, given that the potential gain of costs and synergies derived from the elimination of duplication of networks and services occurs mainly in national mergers.

Furthermore, the progress towards the banking union (based on three pillars: the single supervisory mechanism, the single resolution mechanism and the European Deposit Guarantee Fund) could have resulted in a more competitive scenario in the euro area, although as mentioned before, the Banking Union may not be working as it should or as it is intended to. Several elements of the banking union still have to be developed, being the Common Deposit Guarantee Fund (EDIS) the one that stands out the most. This is, in part, due to the regulatory heterogeneity across countries and the lack of a fiscal union. The monetary union, without this fiscal union, remains incomplete and creates vulnerabilities for future financial crises.

However, bank profitability cannot be affected only by regulation and market structure. Currently, banks face a scenario of reduced margins, associated with persistent low interest rates as a result of the expansionary monetary policies, particularly in Europe, which could hamper profitability. The flat yield curve erodes the profits derived from the maturity transformation, which is the core of the banking business. Additionally, the negative deposit facility interest rate in the euro area is penalizing banks for excess of liquidity, directly affecting their profitability. The latter is, in some cases, below the cost of

raising capital, affecting bank prices in the stock market. According to the *Consolidated Banking Data* of the ECB, the return on equity in 2018 was 5.38% in the euro area, 8.19% in Spain, 2.42% in Germany, 6.47% in France and 5.76% in Italy. In all cases, profitability is below that required by the investor (10%). The ECB approved and reported in a press release in September 2019 a reduction of 10 basis points (bp) in the deposit facility interest rate, currently set at -0.50%. This reduction has a moderating effect on the returns in the short-term of the various interest rate curves, reducing the cost of financing for families and businesses. However, a system of two tranches for the remuneration of reserves was also announced, which implies that the negative deposit facility interest rate will not apply to a portion of the excess liquidity maintained by banks. This last ECB measure, in the form of staggered remuneration of excess of liquidity, aims to mitigate the negative impact on bank profitability of the new cut in the remuneration of reserves. The ECB also reinforced its forward guidance on interest rates, indicating that these will remain at current or even lower levels, until a strong convergence of inflation prospects is observed.

Finally, bank profitability can also be negatively affected by the legal risk and the reputational risk that banks face. In fact, the Bank of Spain, in its latest Financial Stability Report, included the cost of litigation as one of the main risks. However, this problem is not restricted to Spanish banks. The increase in legal costs, as a result of the high number of judicial processes in which banks have been involved, has a direct impact on the profitability of the sector. The manifestation of legal risk, among other factors, has resulted in a loss of reputation for the banking sector, and the deterioration of reputation

can lead to a loss of business in the medium term should the situation is not reversed. In this regard, banks should strive to reverse this situation, providing their clients with the financial products, appropriate to their needs and capabilities, as well as providing the relevant information in a clear and transparent manner.

This doctoral thesis focuses on the analysis of different aspects of the banks' behavior in the current economic situation. The three core chapters are grouped around three specific issues. The **third chapter** analyzes the effect of the increase in capital requirements brought in under Basel III framework and the changes in the deposit insurance scheme on the bank's net interest margin in the aftermath of the financial crisis. The **fourth chapter** explores the effect of bank restructuring (with the consequent closing of banks and branches and the subsequent reduction of multimarket contacts) on competition. Finally, the **fifth chapter** analyzes the effect of the current expansionary monetary policy, more specifically the low interest rate and the flattened slope of the yield curve, on the net interest margin and on bank profitability.

Regulation and bank net interest margins

The banking industry, from the outbreak of the financial crisis a decade ago, has been subjected to a regulatory tsunami. Basel III was born with the objective of strengthening the regulation, supervision and management of risks in the banking sector, overcoming the Basel II deficiencies detected during the crisis. The third Basel agreement, in the attempt to strengthen the capital of banks, requires more capital of higher quality, a capital conservation buffer, a counter cyclical capital

buffer and measures to avoid systemic risk. In addition, it also applies minimum liquidity requirements. Although the minimum capital requirement of 8% established in Basel I and II is maintained, the composition of that capital is modified, requiring greater weight of high-quality capital. Therefore, the Basel III framework brought greater and stricter capital requirements. The benefits of increased capital requirements are clear: more capital reduces the probability of financial distress, but the effects on banks' margins have received scant analytical attention.

The deposit insurance scheme has also changed in preparation for the European deposit guarantee fund. The benefits of deposit regulation are also clear: a better deposit guarantee scheme increases depositors' confidence in the bank, reducing the probability of bank runs. However, deposit insurance has received criticism for introducing moral hazard, by encouraging banks to adopt riskier banking practices to compensate that they cannot invest part of the deposits in profitable assets. Analysis of its effects on bank margins is also scarce.

In this context, the **third chapter** of this thesis focuses precisely on this issue: the effects of the changes in the abovementioned two areas of regulation on the interest margin and its determinants. To do so, the determinants of bank interest margin for a sample of 31 OECD countries during the period 2000-2014 are analyzed, both theoretically and empirically.

The main results obtained show that higher capital requirements are associated with higher interest spreads. The increase in the minimum capital requirement implies that banks rely more on a more expensive source of funds, capital than other alternatives such as debt.

This may erode profitability and therefore the bank's wealth. In consequence, banks will charge higher margins to compensate for this cost of maintaining the required high levels of capital.

The results also suggest that the deposit insurance requirements have a positive influence on the net interest margin. An increase in the deposit insurance premium means the bank cannot invest part of the deposits in profitable assets and the bank will set higher margins to compensate for this opportunity cost. Moreover, with the existence of deposit insurance the risk assumed by depositors is lower and they will demand a lower interest rate for their deposits. As for the remaining determinants of the net interest margin, those banks with greater market power and that are more efficient enjoy a greater net interest margin. Also, those banks with higher average operating costs and implicit payments set a higher interest margin, since the interest margin should cover, at least the operating costs.

Accordingly, the increased regulatory standards introduced after the outbreak of the crisis imply greater banking stability, together with incentives for banks to act more prudently. However, according to our results, the cost of the increased stability will be transferred to banks' customers in the form of higher interest rates on their loans or reduced interest rates on their deposits. This is especially relevant considering the entry into force of the final phase of Basel III (or Basel IV). This implementation, according to a report of the European Banking Authority (EBA) dated August 2019, will entail an increase of the Risk Weighted Assets (RWA) of 24.4% in the European Union banks,

which implies an additional 135,000 million euros of capital to respond to the new needs[37].

Effects of bank restructuring on the multimarket banking competition

After the financial crisis, the need for bank restructuring, mainly aimed at reducing the installed capacity, has led to multiple mergers and acquisitions. One of the most deeply affected sectors by this restructuring was the Spanish banking sector, due to the imbalances accumulated during the pre-crisis period, especially in terms of branches and staffing levels. These mergers and acquisitions have reduced the number of banks in the market and, therefore, have increased the market concentration, affecting the competitive conditions. However, the restructuring has not only reduced the number of players in the arena, but has also modified their branch network, i.e. the number of branches of each firm. According to the *Banking Structural Financial Indicators* of the ECB, the decline in bank numbers for Spain was 43.1% and their number of bank branches reduced by 40.3% (in both cases a much higher decline than in other euro area peers). Therefore, the effect of restructuring on competition may not only respond to a smaller number of banks in the market but also to a reduction in the banks' branch network, affecting the frequency of banking contacts in the market (the number of multimarket contacts) and their intensity.

[37] These estimates have been made under conservative assumptions and assuming that banks do not adjust their portfolios to reduce the impact.

The **fourth chapter** focuses on the effect on competition of branch closures resulting from bank restructuring through the number of markets where banks coincide, that is, the multimarket contacts and their intensity. To do so, the chapter analyzes the determinants of Lerner index corrected for credit risk for the Spanish banking sector during the period 2006-2017. To measure the number of multimarket contacts the index proposed by Coccorese and Pellecchia (2009) is used. In addition, we build a new indicator that, in addition to consider contacts among banks in different geographical markets, also takes into account the intensity of the contacts.

The main results show that the decline in the number of multimarket contacts among Spanish banks is negatively related to market power. This result does not support the hypothesis of collusion in the Spanish banking industry. This hypothesis indicates that multimarket linkages between firms reduce competition, suggesting the existence of collusive behavior between them. However, when the new indicator of multimarket contact that considers the intensity of the contact is used, evidence of tacit collusion is found. That is, if a bank has less branches than its rivals in the markets in which they coincide, its incentives to collude increase. This result confirms the existence of a dominant-fringe equilibrium in the Spanish banking sector. Therefore, dominants banks defend their position in the market through competitive behavior, while the fringe banks simply adapt to the actions of the dominant banks. As for the remaining determinants of the market power, in general, more efficient banks enjoy greater market power. The well-capitalized banks have also more market power, since they are more solvent and have a reduced probability of bankruptcy, being able to raise funds at a lower cost.

Considering all the above, from a policy point of view, the mergers and acquisitions with the consequent closing of branches, have led to a reduced competition in the Spanish banking sector. This is, in part, due to the decline in geographical overlap of the branch networks, associated to less frequent but more intense multimarket contacts. Should these effects continue, particularly in view of the forthcoming wave of mergers and acquisitions in Europe, and are not offset by other procompetitive factors, they may make market conditions even more difficult, leading to welfare losses in the Spanish banking sector. Mergers and acquisitions can be a way to gain efficiency and profitability, but they are very complex operations, whose business plan must be properly valued and, of course, ensure that it does not compromise banking competition. An option to value is cross-border mergers. Until now, these are nonexistent, in part, because of the different regulations across countries. So, a homogenization in the matter of regulation could help.

In addition, with the emergence of the *big tech*, a homogeneous and equal regulation would be necessary for all competitors in the market, with an internationally coordinated supervision and regulation activity, to ensure a competitive environment and this type of firms does not consolidate a position of dominance. *Fintech* and *big tech* are a real threat for banks, but in some segments of bank's activity, where the information asymmetries are more intense, the proximity and the informal information gathered directly in the branch it is still important. **Fourth chapter** shows that the restructuring of the Spanish banking sector do have consequences in terms of the competitive conditions.

Finally, when assessing the effects of mergers and acquisitions on competition, the defense of competition authorities use concentration indicators. The limitations of this type of indicators are well-known, so alternative measures should be sought in the field of competition assessment.

Low interest rates and the slope of the yield curve: effects on margins and profitability

The expansionary monetary policy, implemented by the main central banks in order to combat the negative effects of the financial crisis that erupted in 2008, has led to an extended period of low – or even negative – interest rates, which lasts until today. The potential side effects of this situation of low interest rates on bank profitability are especially relevant considering that, in some cases such as the European banking sector, bank profitability is below the cost of raising capital, negatively affecting the prices of banks in the stock markets. Low interest rates maintained for an extended period may reduce banks' margins and, therefore, their profitability. With negative interest rates, the existence of an effective lower limit on the remuneration of deposits (as customers are not expected to accept a negative deposit interest rate) makes it difficult to transfer the decline in interest rates to the interest on deposits and thus the financial margins narrow. The flat yield curve erodes the profits derived from the maturity transformation, which is the core of the banking business.

The **fifth chapter** focuses on the effect of both low interest rates and a flatter yield curve on both bank profitability and its main component, the net interest margin. To do so, an in-depth analysis on the link between monetary policy and bank profitability, for 31 OECD

countries over the period 2000-2017, is carried out. Particularly, it focuses on the effect of both the interest rate levels and the yield curve on both profitability and the banks' main source of earnings, namely net interest margin.

The main results show that the expansionary monetary policy measures -with the consequent reduction in interest rates and the flattening of the yield curve- had a negative impact on net interest margins and, therefore, on bank profitability. That is, the negative effect of low interest rates on net interest margin is not offset by other factors, being negative the net effect on bank profitability. The impact is greater the lower the interest rate and the flatter the yield curve are.

In this context, the problem of low profitability that some banking sectors suffer—with profitability below the cost of capital in some countries—will persist as long as the current scenario of low interest rates remains. For the specific case of the euro area, the ECB recently reinforced its forward guidance on interest rates, indicating that these will remain at current levels, or lower, until a solid convergence of the inflation perspectives—close but lower than the ECB's 2% target—is reached.

Considering the low rate of GDP growth, and the current scenario of low inflation, monetary policy will remain expansionary for some considerable time. This means that the low interest-rate scenario will also persist. Low profitability could increase the likelihood that banks will assume a greater risk in order to compensate for that low profitability. In this scenario, financial stability could be compromised. Given this situation, the major challenge for those banks with low profitability is to increase efficiency by cutting costs (further reducing the excess of capacity) and by finding other sources

of income other than interest, where non-traditional income is becoming more important. But above all, the additional efficiency gains seem to be closely linked to the technological transformation. Technological adaptation requires in many cases significant investments in systems, However, these investments will become the key of the future income statement, as the percentage of online users grows every year and, according to this trend, the potential for cost savings is significant. Finally, banks should recover customer trust as soon as possible.

All in all, there are many challenges that banks should face in the current scenario of low interest rates and low profitability, and with increasingly stringent regulation. Some potential alternatives to cope with these challenges are the regain of customers' trust to improve their reputation, the increase of their efficiency by cutting costs, the finding of different non-traditional sources of income, and their commitment to technological change in order to gain additional efficiency and adaptation to the new financial regulation framework.

SUMMARY

Summary

The outbreak of the financial crisis more than a decade ago drew a new environment that has affected the characteristics of the banking business, including profitability, margins, cost structure and banks' income sources. On the one hand, as a consequence of the crisis, regulation has tightened with greater (and more stringent) capital requirements, new liquidity coefficients and leverage coefficients, etc., which affect banks' behavior. On the other hand, banks face a scenario of reduced net interest margins, associated with low interest rates as a result of the expansionary monetary policy measures implemented to combat the negative effects of the crisis, which might be reducing profitability. The flattening of the slope of the yield curve erodes profits derived from the maturity transformation, which is the essence of the banking business. In addition, in the case of the euro area, the negative interest rate on the deposit facility is penalizing banks for excess liquidity, which also directly affects their profitability. The latter is, in some cases, lower than the cost of raising capital, which affects the price of banks in the stock markets. Therefore, to maintain their profitability, banks are forced to reduce costs and increase efficiency, as well as to change their income structure, where non-traditional income becomes more important.

In addition, competitive conditions in the European banking sector have also been modified. The need for bank restructuring, with the main objective of reducing the installed capacity, has resulted in multiple mergers and acquisitions. These have increased market concentration, which can be detrimental to the competition. The effects of this new environment on competition not only respond to a fewer number of banks in the market, but also to the fact that the associated closure of branches has affected the number and the intensity of contacts between banks. In addition, the progress towards banking union (based on three pillars: a single supervisory mechanism, a single resolution mechanism and the European deposit guarantee fund), points to the recovery of the levels of financial integration reached before the crisis, but it is also giving rise to a more competitive scenario. Finally, new technologies are also increasing competition in the financial sector due to the emergence of new companies, the so-called *fintech* and *big tech*, which increase the pool of the potential suppliers of financial products and services.

In this context, this doctoral thesis focuses on the analysis of the aforementioned aspects: the effect on the net interest margin of a stricter banking regulation in terms of capital requirements and deposit insurance scheme; the effect of the bank restructuring process on competition; and the effect of the current expansionary monetary policy on bank profitability. The study of these issues raises the following three questions: 1) How and to what extent do the new (and increasing) capital requirements and changes in the deposit insurance schemes, more sensitive to the risk assumed, affect the bank net interest margin? 2) What is the net impact of the current expansionary monetary policy on bank profitability?; and 3) What effect the

restructuring, and the associated bank branch closure, has had on competition?

These questions focus the analysis of the three core chapters of the thesis, although they are addressed using different datasets, adjusted to the needs of the problems. The first chapter, introductory, and the second, methodological, describe and motivate these three topics addressed in this doctoral thesis. In the following chapters (chapters 3 to 5), each of these three aspects is studied in-depth. Thus, the **third chapter** analyzes, from both a theoretical and empirical point of view, the effects of the increase in the capital requirements introduced in the framework of Basel III and the changes in the deposit insurance scheme in the bank net interest margin. The **fourth chapter** focuses on the effect of the restructuring of the Spanish banking sector, both in terms of reducing banks and their branches, on the intensity of competition. In this chapter we measure the changes in the number of multimarket contacts, as well as the changes in the intensity of these contacts and their effects on competition. Finally, the **fifth chapter** examines the effect of the current expansionary monetary policy, with low interest rates and more flattened slope of the yield curves, on the net interest margin and bank profitability. Finally, a conclusions chapter summarizes the main results obtained.

Regulation and bank net interest margins

As mentioned in the previous paragraphs, net interest margins have been reduced since the outbreak of the financial crisis and the banking environment has changed. On the one hand, the main central banks have carried out expansive monetary policies to combat the

negative effects of the crisis, reducing margins as a consequence. In addition, competitive conditions have also changed due to the reduction in the number of banks and their branches, and the emergence of new players in the bank playground (*fintech, big tech*, etc.). Finally, there has been a regulatory tsunami, with new and stricter capital standards, a more stringent deposit insurance scheme and liquidity ratios, limits on bank leverage, etc.

From all the aforementioned factors that affect bank net interest margins, the **third chapter** focuses on the effect of both the increase in capital requirements introduced in the framework of Basel III, and the changes in the deposit insurance scheme in preparation for the European deposit guarantee fund. The benefits of increased capital requirements are clear from the point of view of financial stability: more capital reduces the probability that banks will suffer financial difficulties, improving solvency. However, this greater financial stability may have a cost for customers if banks are able to transfer the cost of greater capital. The benefits of deposit regulation are also clear: a better deposit guarantee scheme increases depositors' confidence in the bank, reducing the probability of bank runs. However, deposit insurance has also received criticism for introducing moral hazard, by encouraging banks to adopt riskier banking practices. The question posed in the chapter is whether banks transfer the cost of these higher requirements to their clients by setting a greater net interest margin.

Therefore, the **third chapter** analyzes bank net interest margins and their determinants, focusing on the effect of regulatory variables. Taking as a starting point the theoretical model of Ho and Saunders (1981), together with the extensions of Allen (1988), Angbazo (1997),

and Maudos and Fernández de Guevara (2004), a new extension is developed. It includes two additional determinants: the deposit insurance scheme and the capital requirements, and shows that the potential determinants of the net interest margin are market power, the degree of risk aversion, the average size of operations, average operating costs, money market volatility, credit risk, the interaction between interest rate risk and credit risk, the deposit insurance premium and the minimum capital requirement percentage. The model predicts that the higher the capital requirements, the greater the net interest margin. This implies that banks effectively transfer that additional cost to their customers through higher margins.

In the case of deposit insurance, the model does not predict a unique effect. On the one hand, there is a direct effect of the deposit insurance premium, which implies an opportunity cost of not investing those funds in more profitable assets and the bank would set a greater interest margin to compensate for it. On the other hand, there is an indirect effect, since the risk assumed by depositors is lower and, therefore, the interest rate they demand for their deposits is also lower, increasing the bank's interest margin. However, a higher deposit insurance premium can also lead to riskier lending strategies by banks to offset the opportunity cost. Therefore, the effect of deposit insurance on the net interest margin depends on which effect predominates.

After the theoretical development, an empirical analysis is carried out using a data panel composed of banks from 31 OECD countries for the period 2000-2014. The fact of having a sufficiently long period, comprising a sub-period before and after the financial crisis,

has allowed us to control the effect that the crisis has had on the net interest margin.

The empirical estimation adopts the two-step system Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). As a dependent variable, the net interest margin is used. As explanatory variables, in addition to the lagged dependent variable to capture the inertia effects of the margin, the resulting variables of the theoretical model, together with variables that are commonly used in the previous related literature, are included. Time effects are also included to reflect the impact of particular shocks in each year that affect the dependent variable. Therefore, the following equation models the net interest margin of a bank *i* in year *t*:

$$
\begin{aligned}
&Net\ Interest\ Margin_{it} \\
&\quad = \beta_0 + \beta_1 Net\ Interest\ Margin_{it-1} \\
&\quad + \beta_2\ Implicit\ interest\ payments_{it} + \beta_3 Efficiency_{it} \\
&\quad + \beta_4 Lerner\ index \\
&\quad + \beta_5 Interest\ rate\ risk_{it} + \beta_6\ Credit\ risk_{it} \\
&\quad + \beta_7\ Risk\ covariance_{it} + \beta_8 Loan_{it} + \beta_9 Risk\ aversion_{it} \\
&\quad + \beta_{10} Average\ cost_{it} + \beta_{11} Reserves_{it} \\
&\quad + \beta_{12} Capital\ stringency_{it} \\
&\quad + \beta_{13} Deposit\ insurance_{it} + \beta_{14} GDP\ growth_{it} + \varepsilon_i + \alpha_t \\
&\quad + u_{it}
\end{aligned}
\tag{1}
$$

where ε_i are individual effects and α_t are time effects. In addition to the estimation of the previous equation, robustness tests are

performed, using alternative measures of some variables, as well as different samples.

The results of the empirical analysis show that the net interest margin depends mainly on market power, average operating costs, liquid reserves, implicit interest payments, the management efficiency, capital requirements and the deposit insurance. Therefore, the empirical analysis supports the importance of the theoretical extension developed in the chapter. The results also show that the crisis has had a negative effect on the net interest margin.

Therefore, keeping the rest of the determinants constant, the greater capital requirements and a more demanding deposit insurance scheme translate into a higher net interest margin. This conclusion is particularly relevant as regulators seek to guarantee financial stability by imposing more stringent requirements on banks. However, the results indicate that banks respond by increasing their net interest margins to offset the cost of this greater capital they must maintain. This implies that the cost of stricter regulations is ultimately borne by consumers. Although interest rates are currently very low, in the event that the pace of monetary policy changes and becomes more restrictive, bank net interest margins will increase due to new regulatory restrictions. In summary, the increase in regulatory standards introduced after the outbreak of the crisis implies greater bank stability. However, the cost of this greater stability is transferred to the bank's customers in the form of higher interest rates on their loans or lower interest rates on their deposits, that is a higher net interest margin.

Effects of bank restructuring on the multimarket banking competition

As mentioned before, the outbreak of the financial crisis in 2008 has led to changes in the competitive conditions in the European banking sector. On the one hand, the need for bank restructuring, with the main objective of reducing the installed capacity, has resulted in multiple mergers and acquisitions, increasing market concentration. In addition, these mergers and acquisitions have reduced the size of the banks' branch network due to the closure of a large number of them. On the other hand, the process towards banking union, to recover the levels of financial integration reached before the crisis, has given rise to a market that is more open to competition. In addition, new technologies are jeopardizing the traditional banking markets due to the emergence of the *fintech* and *big tech* firms. These types of companies increase competition in the financial sector, expanding the pool of potential suppliers of financial products and services.

The **fourth chapter** focuses on the effect of closing branches as a result of bank restructuring on competition. This effect is measured through the number of markets where banks coincide, that is, the number of multimarket contacts, as well as their intensity. The analysis is carried out for the Spanish banking sector, as it is one of the most affected sectors in Europe by the restructuring due to the imbalances accumulated during the period prior to the crisis, especially in terms of branches and employees.

Accordingly, the evolution of market power in the Spanish banking sector during the period 2006-2017 is analyzed, using the Lerner index corrected by credit risk, and analyzing its determinants, focusing on the effect of closing branches as a consequence of the

bank restructuring, in particular through the number of multimarket contacts and their intensity. For this, different multimarket contact indicators are used. On the one hand, the multimarket contact indicator of Coccorese and Pellecchia (2009) is used. On the other hand, a new indicator is proposed and constructed, which not only considers the existence of contacts between banks, but also the intensity of these contacts. Intensity is measured through the bank's dominance/weakness situation in terms of the number of branches with respect to its rivals, in the markets where they coincide. Therefore, this last indicator also makes it possible to test the existence of a dominant-fringe equilibrium in the market in the Spanish banking sector. This equilibrium implies that the dominant banks, in terms of number of branches, compete with each other to maintain their position in the market; while banks with fewer branches than their competitors in those markets where they coincide adapt to the actions of the dominant banks, colluding.

The main hypothesis in the literature about the effect of the multimarket contacts on competition assumes a negative effect. This hypothesis comes from the seminal work of Edwards (1955) and postulates that companies operating in the same geographic markets could have a lower incentive to compete in a given market if they fear reprisals from their rivals not only in that market, but in all those where they meet. Following the seminal work of Solomon (1970), other studies also find evidence on the opposite hypothesis, a positive effect of multimarket contacts on competition, rejecting collusive behavior among companies. Therefore, to date, the results are ambiguous and more empirical evidence is necessary.

In the empirical analysis, the dependent variable is the Lerner index corrected by credit risk. As potential determinants of the Lerner index, we include those considered by the standard Monti-Klein model for the case of oligopolistic competition that shows that market power depends on the number of competitors and the elasticity of demand. In addition, following an approach of conjectural variation, in which companies form expectations (conjectures) about the reactions (variations) of competitors, these variations would also be part of the determinants of market power, being approximated by the number and intensity of multimarket contacts. In addition, the standard model has been extended in other works of the previous literature with the objective of incorporating additional explanatory variables of market power. Thus, Corvosier and Gropp (2002), Fernández de Guevara et al. (2005) and Fernández de Guevara and Maudos (2007), among others, show that market power depends on the specific variables of the bank, market concentration and the elasticity of demand. Therefore, as determinants of the Lerner index, we include a multimarket contact indicator/intensity of the multimarket contact indicator, market concentration, liquid reserves, the management efficiency, the percentage of loans on total assets, capitalization of the bank and the GDP growth. Multimarket contact indicators are constructed using the information of each bank branch in Spain. The relevant market considered for multimarket indicators is the zip code.

In some specifications, the lagged dependent variable is included to capture the inertia effects of the Lerner index of market power. In these cases, the empirical estimation adopts the two-step system Generalized Method of Moments (GMM) dynamic panel estimator.

Time effects are also included to reflect the impact of particular shocks in each year that affect the dependent variable. In addition, the robustness of the results is tested using an alternative sample, which only includes banks that operate in more than one market, that is, the subset of multimarket banks, discarding those that only operate locally in a zip code.

The results obtained suggest that the decrease in multimarket contacts between Spanish banks is negatively related to market power, being non-linear this relationship, specifically U-shaped. Since the vast majority of the observations in the sample are located in the decreasing part of this U-shaped function, we can assume a negative relationship between market power and multimarket contacts. Therefore, this result does not support the hypothesis of collusion in the Spanish banking sector, since the greater the number of contacts between banks, the lower the market power. However, when the new multimarket contact indicator that considers the intensity of the contact is used, the opposite image emerges and evidence of tacit collusion is found. That is, if a bank has fewer branches than its rivals in the markets where they coincide, their incentives to collude are increased. Therefore, it is important to take into account not only the number of multimarket contacts, but also their intensity. Consequently, the recent reduction in the number of multimarket contacts and the increase in the intensity of these contacts in the Spanish banking sector has increased the market power of Spanish banks. Finally, the existence of a dominant-fringe equilibrium in the Spanish banking sector is also confirmed.

Low interest rates and the slope of the yield curve: effects on margins and profitability

The expansive monetary policy, implemented by the main central banks to combat the negative effects of the financial crisis that broke out in 2008, has led to a prolonged period of low (or even negative) interest rates. The possible effects of low interest rates on bank profitability are especially relevant considering that, in some cases, such as the European banking sector, bank profitability is currently below the cost of raising capital, which negatively affects the price of banks in the stock markets. This low profitability is due to several reasons (such as the high volume of unproductive assets, the greater (and stricter) regulation, the competition of the *fintech* and *big tech*, etc.). In addition, in the case of European banks, the negative interest rate on the deposit facility is penalizing banks for excess liquidity, directly affecting their income statement and, therefore, their profitability.

Low interest rates maintained over a prolonged period can reduce bank margins, which affects their profitability. With negative interest rates, the existence of an effective lower limit on the remuneration of deposits (since customers are not willing to accept a negative deposit interest rate) makes it difficult to transfer low interest rates to the interest rates on deposits and, therefore, narrows the net interest margin. In this context, the **fifth chapter** analyzes in-depth the link between monetary policy and bank profitability, focusing on the effect of the level of interest rates and the slope of the yield curve on profitability, as well as on the net interest margin, as the main component of this.

Therefore, the **fifth chapter** studies the effect of the current expansionary monetary policy on bank profitability using a sample of banks from 31 OECD countries during the period 2000-2017, which includes the years of economic expansion, the years of financial crisis and the years of subsequent economic recovery. The empirical evaluation is performed using the two-step system Generalized Method of Moments (GMM) dynamic panel estimator. As a dependent variable, the net interest margin and the return on assets (ROA) are used alternately. The determinants of these variables include, in addition to the lagged dependent variable lagged to control for the inertia in the trend, the level of interest rates, the slope of the yield curve, the Lerner index of market power (corrected by credit risk), the credit risk, interest rate risk, the interaction between risks, bank size, the degree of risk aversion, operating costs (only in the case of the net interest margin as a dependent variable, since in the case of ROA the variable approximated for the average operating costs is an identity variable), implicit interest payments, liquid reserves, the management efficiency and GDP growth. In addition, the square of both the level of interest rates and the rate curve is included to capture a possible non-linear relationship. Time effects are also included to control for the impact of specific shocks of each year.

Therefore, the following equations for the net interest margin and the profitability, respectively, are estimated of a bank *i* in year *t*:

$$
\begin{aligned}
&Net\ interest\ margin_{it} \\
&\quad = \beta_0 + \beta_1\ Net\ interest\ margin_{it-1} \\
&\quad + \beta_2\ Interest\ rates\ level_{it} \\
&\quad + \ \beta_3\ Interest\ rates\ level_{it}^2 \\
&\quad + \beta_4\ Slope\ of\ the\ yield\ curve_{it} \\
&\quad + \beta_5\ Slope\ of\ the\ yield\ curve_{it}^2 + \beta_6\ Lerner\ index_{it} \\
&\quad + \beta_7\ Credit\ risk_{it} + \beta_8\ \ Interest\ rate\ risk_{it} \\
&\quad + \beta_9\ Risk\ interaction_{it} + \beta_{10}\ Size_{it} + \beta_{11}\ Risk\ aversion_{it} \\
&\quad + \beta_{12}\ Operating\ costs_{it} + \beta_{13}\ Implicit\ payments_{it} \\
&\quad + \beta_{14}\ Liquid\ reserves_{it} + \ \beta_{15}\ Efficiency_{it} \\
&\quad + \beta_{16}\ GDP\ growth_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
&Return\ on\ Assets_{it} \\
&\quad = \beta_0 + \beta_1\ Return\ on\ Assets_{it-1} \\
&\quad + \beta_2\ Interest\ rates\ level_{it} \\
&\quad + \ \beta_3\ Interest\ rates\ level_{it}^2 \\
&\quad + \beta_4\ Slope\ of\ the\ yield\ curve_{it} \\
&\quad + \beta_5\ Slope\ of\ the\ yield\ curve_{it}^2 + \beta_6\ Lerner\ index_{it} \\
&\quad + \beta_7\ Credit\ risk_{it} + \beta_8\ \ Interest\ rate\ risk_{it} \\
&\quad + \beta_9\ Risk\ interaction_{it} + \beta_{10}\ Size_{it} + \beta_{11}\ Risk\ aversion_{it} \\
&\quad + \beta_{12}\ Implicit\ payments_{it} + \beta_{13}\ Liquid\ reserves_{it} \\
&\quad + \ \beta_{14}\ Efficiency_{it} + \beta_{15}\ GDP\ growth_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{3}
$$

where ε_i are individual effects and α_t are time effects.

The results show that the current expansionary monetary policies have a negative impact on net interest margins and, therefore, on bank profitability, through low interest rates and flattening of the slope of

the yield curve. The relationship between the interest rate and the interest margin is non-linear. This reflects, among other things, that the reduction of the net interest margin is greater as the interest rate is lower. The reason is that the interest rate on deposits cannot fall below zero. The same applies to the relationship between the interest rate and profitability. In the case of the yield curve, the relationship is also non-linear, for both the net interest margin and profitability. The more flattened the slope of the yield curve, the greater the reduction in the net interest margin profitability. Therefore, the problem of low profitability that some particular banking sectors are facing will persist as long as the current scenario of low interest rates continues, which could affect financial stability.

RESUMEN

Resumen

Este último capítulo presenta un resumen en castellano de los tres capítulos centrales incluidos en esta tesis doctoral para cumplir con la normativa de la Universitat de València, ya que el resto de la tesis está escrita en una lengua diferente de las oficiales de la Universitat[38]. Se resumen a continuación los principales objetivos, la metodología utilizada, los principales resultados y conclusiones obtenidas.

El estallido de la crisis financiera hace ya más de una década, dibujó un nuevo entorno que ha afectado a las características del negocio bancario y la rentabilidad, márgenes, estructura de costes y fuentes de ingresos de los bancos. Por un lado, como consecuencia de la crisis, la regulación se ha endurecido con mayores (y más estrictos) requerimientos de capital, nuevos coeficientes de liquidez y apalancamiento, etc., que afectan al comportamiento de los bancos. Por otro lado, los bancos se enfrentan a un escenario de márgenes de intermediación reducidos, asociados a bajos tipos de interés como resultado de las políticas monetarias expansivas que se están llevando a cabo para combatir los efectos negativos de la crisis económica, lo

[38] Artículo 7.2 del Reglamento sobre depósito, evaluación y defensa de la tesis doctoral, aprobado por el Consejo de Gobierno del 28 de junio de 2016 y modificado el 31 de octubre de 2017.

que podría estar reduciendo la rentabilidad. El aplanamiento de la curva de tipos erosiona las ganancias derivadas de la transformación de vencimientos, que es la esencia del negocio bancario. Además, en el caso de la Eurozona, los tipos de interés negativos en la facilidad de depósito están penalizando a los bancos por el exceso de liquidez, lo que también afecta directamente a su rentabilidad. La rentabilidad es, en algunos casos, inferior al coste de captar capital, lo que afecta al precio de cotización de los bancos en el mercado de valores. Por lo tanto, para mantener su rentabilidad, los bancos se ven obligados a reducir costes y a aumentar la eficiencia, así como a cambiar su estructura de ingresos, donde los ingresos no tradicionales se vuelven más importantes.

Además, las condiciones competitivas en el sector bancario europeo también se han modificado. La necesidad de una reestructuración bancaria, con el objetivo principal de reducir la capacidad instalada, ha dado lugar a múltiples fusiones y adquisiciones. Estas fusiones y adquisiciones han aumentado la concentración del mercado, pudiendo ser esto perjudicial para la competencia. Los efectos de este nuevo entorno sobre la competencia no solo responden a un menor número de bancos en el mercado, sino también al hecho de que el cierre de oficinas ha afectado al número y la intensidad de los contactos entre bancos. Además, el progreso hacia la unión bancaria (basado en tres pilares: el mecanismo único de supervisión, el mecanismo único de resolución y el Fondo de Garantía de Depósitos europeo), apunta a la recuperación de los niveles de integración financiera alcanzados antes de la crisis, pero también está dando lugar a un escenario más competitivo. Finalmente, las nuevas tecnologías también están aumentando la competencia en el sector

financiero debido a la aparición de nuevas empresas, las llamadas *fintech* y *big tech*, que aumentan la oferta de productos y servicios financieros.

En este contexto, esta tesis se centra en el análisis de los aspectos antes mencionados: el efecto sobre el margen de intermediación de una regulación bancaria más estricta en términos de requisitos de capital y seguro de depósitos; el efecto del proceso de reestructuración bancaria en la competencia; y el efecto de la actual política monetaria expansiva sobre la rentabilidad bancaria. El estudio de estas cuestiones plantea las siguientes tres cuestiones: 1) ¿Cómo y en qué medida afectan los nuevos requisitos de capital (en aumento) y los cambios en los esquemas de seguro de depósito, más sensibles al riesgo asumido, al margen de intermediación bancario? 2) ¿Cuál es el impacto neto de la actual política monetaria expansiva en la rentabilidad bancaria? 3) ¿Qué efecto ha tenido la reestructuración, y el cierre de oficinas asociado, en la competencia?

Estas preguntas centran el análisis que se realiza en los tres capítulos principales de la tesis, aunque se abordan utilizando diferentes conjuntos de datos, ajustándose a las necesidades del problema. El primer capítulo, introductorio, y el segundo, metodológico, describen y motivan estos tres temas que aborda la tesis doctoral. En los capítulos siguientes, del tercero al quinto, se profundiza en cada una de estos tres aspectos. Así, el **tercer capítulo** analiza, tanto desde un punto de vista teórico como empírico, los efectos del aumento de los requisitos de capital introducidos en el marco de Basilea III y los cambios en el esquema de seguro de depósitos en el margen de intermediación bancario. El **cuarto capítulo** se centra en el efecto de la reestructuración del sector

bancario español, tanto en términos de reducción de los bancos como de sus oficinas, sobre la intensidad de la competencia. En este capítulo medimos los cambios en el número de contactos multimercado, así como los cambios en la intensidad de estos contactos y sus efectos en la competencia. Por último, el **quinto capítulo** examina el efecto de la política monetaria expansiva actual, con bajos tipos de interés y curvas de tipos más aplanadas, sobre el margen de intermediación y la rentabilidad bancaria. Por último, el capítulo de conclusiones sintetiza los principales resultados obtenidos.

Regulación y márgenes de intermediación bancarios

Como se mencionó anteriormente, los márgenes de intermediación se han reducido desde el estallido de la crisis financiera y el entorno bancario también ha cambiado. Por un lado, los principales bancos centrales han llevado a cabo políticas monetarias expansivas para combatir los efectos negativos de la crisis, reduciéndose los márgenes como consecuencia. Además, las condiciones competitivas también han cambiado debido a la reducción del número bancos y oficinas bancarias, y al surgimiento de nuevos actores en el panorama financiero (*fintech*, *big tech*, etc.). Finalmente, ha habido un tsunami regulatorio, con estándares de capital nuevos y más estrictos, un esquema de seguro de depósitos también más estricto y coeficientes de liquidez, límites al apalancamiento bancario, etc.

De todos los factores mencionados que afectan a los márgenes de intermediación bancarios, el **tercer capítulo** se centra en el efecto tanto del aumento en los requisitos de capital introducidos en el marco de Basilea III, como de los cambios en el esquema de seguro de

depósitos en preparación para el Fondo de Garantía de Depósitos europeo. Los beneficios del aumento de los requisitos de capital son claros desde el punto de vista de la estabilidad financiera: más capital reduce la probabilidad de que los bancos sufran dificultades financieras, mejorando la solvencia. Sin embargo, esta mayor estabilidad financiera puede tener un coste para los clientes si los bancos son capaces de trasladar el coste de operar con mayores recursos propios. Los beneficios de la regulación de depósitos también son claros: un mejor esquema de garantía de depósitos aumenta la confianza de los depositantes en el banco, reduciendo la probabilidad de un pánico bancario, aunque también ha recibido críticas por incentivar el riesgo moral al alentar a los bancos a adoptar prácticas más arriesgadas. La pregunta planteada en el capítulo es si los bancos transfieren el coste de estos mayores requisitos a sus clientes en forma de un mayor margen de intermediación.

Por lo tanto, el **tercer capítulo** analiza los márgenes de intermediación bancarios y sus determinantes, enfocándose en el efecto de las variables regulatorias. Tomando como punto de partida el modelo teórico de Ho y Saunders (1981), junto con las extensiones de Allen (1988), Angbazo (1997), y Maudos y Fernández de Guevara (2004), se lleva a cabo una nueva extensión que incluye dos determinantes adicionales: el esquema de seguro de depósitos y los requisitos de capital. Tras esta extensión, los determinantes potenciales del margen de intermediación son el poder de mercado, el grado de aversión al riesgo, el tamaño medio de las operaciones, los costes operativos medios, la volatilidad del mercado monetario, el riesgo de crédito, la interacción entre el riesgo de tipo de interés y el riesgo de crédito, la prima del seguro de depósitos y el porcentaje de

requerimiento de capital mínimo. El modelo predice que a mayores requerimientos de capital, mayor margen de intermediación. Esto implica que los bancos efectivamente transfieren ese coste adicional a sus clientes en forma de mayores márgenes.

En el caso del seguro de depósito, el modelo no predice un efecto unívoco. Por un lado, existe un efecto directo de la prima del seguro de depósitos, que supone un coste de oportunidad de no invertir esos fondos en activos más rentables y el banco fijaría un mayor margen de intermediación para compensarlo. Por otro lado, se da un efecto indirecto, ya que el riesgo que asumen los depositantes es menor y, por tanto, el tipo de interés que exigen por sus depósitos también es menor, incrementando el margen de intermediación de los bancos. Sin embargo, una mayor prima de seguro de depósitos también puede dar lugar a estrategias de crédito más arriesgadas por parte de los bancos para compensar el coste de oportunidad. Por tanto, el efecto del seguro de depósitos sobre el margen depende de qué efecto predomine.

Tras el desarrollo teórico, se lleva a cabo un contraste empírico utilizando un panel de datos compuesto por bancos de 31 países de la OCDE para el periodo 2000-2014. El hecho de tener un período suficientemente largo, que comprende un subperíodo anterior y otro posterior a la crisis financiera, ha permitido controlar el efecto que la crisis ha tenido sobre el margen de intermediación.

La estimación empírica se lleva a cabo con una estimación dinámica por el Método Generalizado de Momentos (MGM), desarrollada por Arellano y Bond (1991), Arellano y Bover (1995) y Blundell y Bond (1998). Como variable dependiente se utiliza margen de intermediación y como variables explicativas se incluyen, además de la variable endógena retardada un periodo para controlar por el

efecto de inercia en el margen, las variables resultantes del modelo teórico, junto con variables que se usan comúnmente en la literatura relacionada anterior. Se incluyen también efectos temporales para reflejar el impacto de *shocks* específicos en cada año que afectan a la variable dependiente. Por tanto, la siguiente ecuación modela el margen de intermediación de un banco *i* en el año *t*:

$$
\begin{aligned}
&Margen\ de\ intermediación_{it} \\
&\quad = \beta_0 + \beta_1\ Margen\ de\ intermediación_{it-1} \\
&\quad + \beta_2\ Pago\ implícito\ de\ intereses_{it} + \beta_3\ Eficiencia_{it} \\
&\quad + \beta_4\ Índice\ de\ Lerner_{it} \\
&\quad + \beta_5\ Riesgo\ de\ tipo\ de\ interés_{it} + \beta_6\ Riego\ de\ crédito_{it} \\
&\quad + \beta_7\ Interacción\ entre\ riesgos_{it} \\
&\quad + \beta_8\ Volumen\ de\ préstamos_{it} \\
&\quad + \beta_9\ Grado\ de\ aversión\ al\ riesgo_{it} \\
&\quad + \beta_{10}\ Costes\ operativos\ medios_{it} + \beta_{11}\ Reservas\ líquidas_{it} \\
&\quad + \beta_{12}\ Requerimientos\ de\ capital_{it} \\
&\quad + \beta_{13}\ Seguro\ de\ depósitos_{it} + \beta_{14}\ Crecimiento\ del\ PIB_{it} + \varepsilon_i \\
&\quad + \alpha_t + u_{it}
\end{aligned}
\tag{1}
$$

donde ε_i son los efectos individuales y α_t los efectos temporales y u_{it} la perturbación aleatoria. Además de la estimación de la ecuación anterior, se realizan pruebas de robustez, utilizando medidas alternativas de algunas variables, así como distintas muestras.

Los resultados del análisis empírico muestran que el margen de intermediación depende principalmente del poder de mercado, los costes operativos medios, las reservas líquidas, el pago implícito de intereses, la eficiencia en la gestión, los requisitos de capital y el

seguro de depósitos. Por lo tanto, el análisis empírico apoya la importancia de la extensión teórica realizada en el capítulo. Los resultados también muestran que la crisis ha tenido un efecto negativo y significativo sobre el margen de intermediación.

Por tanto, manteniendo constante el resto de los determinantes, los mayores requisitos de capital y un esquema de seguro de depósitos más exigente se traducen en un margen de intermediación más alto. Esta conclusión es particularmente relevante ya que los reguladores buscan garantizar la estabilidad financiera imponiendo requisitos más estrictos a los bancos. Sin embargo, los resultados indican que los bancos responden aumentando sus márgenes de intermediación para compensar el coste de este mayor capital que deben mantener. Esto implica que el coste de regulaciones más estrictas es asumido finalmente por los consumidores. Aunque los tipos de interés son actualmente muy bajos, en el caso de que el ritmo de la política monetaria cambie y se vuelva más restrictiva, los márgenes de intermediación bancarios aumentarán debido a las nuevas restricciones regulatorias. En resumen, el aumento de los estándares regulatorios introducidos después del estallido de la crisis implica una mayor estabilidad bancaria. Sin embargo, el coste de esta mayor estabilidad se transfiere a los clientes del banco en forma de tipos de interés más altos en sus préstamos o tipos de interés más bajos en sus depósitos, esto es un mayor margen de intereses.

Efectos de la restructuración bancaria sobre la competencia multimercado

Como se comenta anteriormente, el estallido de la crisis financiera en 2008 ha dado lugar a modificaciones en las condiciones competitivas en el sector bancario europeo. Por un lado, la necesidad de una restructuración bancaria, con el objetivo principal de reducir la capacidad instalada, ha dado lugar a múltiples fusiones y adquisiciones, incrementando la concentración del mercado. Además, estas fusiones y adquisiciones han reducido el tamaño de la red de oficinas bancarias debido al cierre de un gran número de ellas. Por otro lado, el proceso hacia la unión bancaria, para recuperar los niveles de integración financiera alcanzados antes de la crisis, ha dado lugar a un mercado más abierto a la competencia. Asimismo, las nuevas tecnologías están poniendo en peligro los mercados bancarios tradicionales debido a la aparición de las *fintech* y las *big tech*. Este tipo de empresas incrementan la competencia en el sector financiero, ampliando la oferta potencial de productos y servicios financieros.

El **cuarto capítulo** se centra en el efecto del cierre de oficinas como resultado de la restructuración bancaria sobre la competencia. Este efecto se mide a través del número de mercados donde los bancos coinciden, es decir, el número de contactos multimercado, así como la intensidad de los mismos. El análisis se realizará para el sector bancario español, ya que es uno de los sectores más afectados a nivel europeo por la restructuración debido a los desequilibrios acumulados durante el periodo anterior a la crisis, especialmente en términos de oficinas y empleados.

Se analiza, por tanto, la evolución del poder de mercado en el sector bancario español durante el periodo 2006-2017, usando el

índice de Lerner corregido por riesgo de crédito, y analiza sus determinantes, centrándose en el efecto del cierre de oficinas como consecuencia de la restructuración bancaria, a través del número de contactos multimercado y su intensidad. Para ello, se utilizan diferentes indicadores de contacto multimercado. Por un lado, se utiliza el indicador de contacto multimercado de Coccorese y Pellecchia (2009). Por otro lado, se propone y construye un nuevo indicador que no solo considera la existencia de contactos entre bancos, sino también la intensidad de estos contactos. La intensidad es medida a través de la situación de fortaleza/debilidad del banco en términos de número de oficinas con respecto a sus rivales, en los mercados en los que coinciden. Por tanto, este último indicador permite contrastar, además, la hipótesis de los modelos de oligopolio con empresa dominante de existencia de un equilibrio *dominant-fringe* en el sector bancario español. Este equilibrio implica que los bancos dominantes, en términos de número de oficinas, compiten entre sí para mantener su posición en el mercado; mientras que los bancos con un menor número de oficinas que sus competidores en aquellos mercados en los que coinciden se adaptan a las acciones de los bancos dominantes, coludiendo.

La principal hipótesis en la literatura sobre el efecto de los contactos multimercado sobre la competencia asume que los contactos multimercado tienen un efecto negativo sobre la competencia. Esta hipótesis proviene del trabajo seminal de Edwards (1955) y postula que las empresas que operan en los mismos mercados geográficos podrían tener un menor incentivo a competir en un mercado dado si temen represalias de sus rivales no solo en ese mercado, sino en todos en los que coinciden. Siguiendo el trabajo seminal de Solomon (1970),

otros estudios encuentran también evidencia sobre la hipótesis contraria, un efecto positivo de los contactos multimercado sobre la competencia, rechazando un comportamiento colusorio entre las empresas. Por tanto, hasta la fecha, los resultados son ambiguos y es necesaria mayor evidencia empírica.

En el análisis empírico, la variable dependiente es el índice de Lerner corregido por riesgo de crédito. Como posibles determinantes del índice de Lerner, incluimos los considerados por el modelo estándar de Monti-Klein para el caso de competencia oligopolística que muestra que el poder del mercado depende del número de competidores y de la elasticidad de la demanda. Además, siguiendo un enfoque de variación conjetural, en el que las empresas forman expectativas (conjeturas) sobre las reacciones (variaciones) de los competidores, estas variaciones también formarían parte de los determinantes del poder de mercado, siendo aproximadas por el número y la intensidad de los contactos multimercado. Además, el modelo estándar se ha extendido en otros trabajos de la literatura anterior con el objetivo de incorporar variables explicativas adicionales del poder de mercado. Así, Corvosier y Gropp (2002), Fernández de Guevara *et al.* (2005) y Fernández de Guevara y Maudos (2007), entre otros, muestran que el poder de mercado depende de las variables específicas del banco, la concentración del mercado y la elasticidad de la demanda. Por lo tanto, como determinantes del índice de Lerner, incluimos un indicador de contacto multimercado/intensidad del contacto multimercado, la concentración de mercado, las reservas liquidas, la eficiencia en la gestión, el porcentaje de préstamos sobre activos totales, la capitalización y el crecimiento del PIB. Los indicadores de contacto

multimercado se construyen utilizando la información de cada oficina bancaria en España. El mercado relevante considerado para los indicadores multimercado es el código postal.

En algunas especificaciones, la variable dependiente retardada un periodo se incluye como variable explicativa para capturar la posible inercia del índice de Lerner de poder de mercado. En estos casos, la estimación empírica adopta el estimador dinámico por el Método Generalizado de Momentos (MGM). Se incluyen también efectos temporales para reflejar el impacto de *shocks* específicos en cada año que afectan a la variable dependiente. Además, se contrasta la robustez de los resultados utilizando una muestra alternativa, que solo incluye los bancos que operan en más de un mercado, es decir, el subconjunto de bancos multimercado, descartando los que únicamente operan localmente en un código postal.

Los resultados obtenidos sugieren que la disminución de los contactos multimercado entre los bancos españoles está relacionada negativamente con el poder del mercado, y que esta es una relación no lineal, específicamente con forma de U. Dado que la gran mayoría de las observaciones en la muestra se ubican en la parte decreciente de la función en forma de U, podemos asumir una relación negativa entre el poder de mercado y los contactos multimercado. Por lo tanto, este resultado no respalda la hipótesis de colusión en el sector bancario español, ya que cuanto mayor sea el contacto entre bancos, menor será el poder de mercado. Sin embargo, cuando se utiliza el nuevo indicador de contacto multimercado que considera la intensidad del contacto, emerge la imagen opuesta y encontramos evidencia de colusión tácita. Es decir, si un banco tiene menos oficinas que sus rivales en los mercados en los que coinciden, aumentan sus incentivos

para coludir. Por lo tanto, es importante tener en cuenta no solo el número de contactos multimercado, sino también su intensidad. En consecuencia, la reciente reducción en el número de contactos multimercado y el aumento en la intensidad de estos contactos en el sector bancario español han incrementado el poder de mercado de los bancos españoles. Finalmente, también se confirme la existencia de un equilibrio *dominant-fringe* en el sector bancario español.

Tipos de interés y curva de tipos: efectos sobre los márgenes y la rentabilidad

La política monetaria expansiva, llevada a cabo por los principales bancos centrales para combatir los efectos negativos de la crisis financiera que estalló en 2008, ha dado lugar a un período prolongado de bajos tipos de interés, o incluso negativos. Los posibles efectos de los bajos tipos de interés sobre la rentabilidad bancaria son especialmente relevantes teniendo en cuenta que, en algunos casos, como el sector bancario europeo, la rentabilidad bancaria está actualmente por debajo del coste de captar capital, lo que afecta negativamente a la cotización de los bancos en los mercados bursátiles. Esta baja rentabilidad se debe a varias razones (como el alto volumen de activos improductivos, la mayor (y más estricta) regulación, la competencia de las *fintech* y *big tech*, etc.). Además, en el caso también de los bancos europeos, el tipo de interés negativo en la facilidad de depósito está penalizando a los bancos por el exceso de liquidez, afectando directamente a su cuenta de resultados y, por lo tanto, a su rentabilidad.

Los bajos tipos de interés mantenidos durante un período prolongado pueden reducir los márgenes de los bancos, lo que afecta

su rentabilidad. Con tipos de interés negativos, la existencia de un límite inferior efectivo en la remuneración de los depósitos (ya que no se espera que los clientes acepten un tipo de interés de depósito negativo) hace que sea difícil transferir los bajos tipos de interés al tipo de interés de los depósitos y, por lo tanto, se estrecha el margen de intermediación. En este contexto, el **quinto capítulo** analiza en profundidad el vínculo entre la política monetaria y la rentabilidad bancaria, centrándose en el efecto del nivel de tipos de interés y la curva de tipos en la rentabilidad, así como en el margen de intermediación, como principal componente de esta.

Por lo tanto, el **quinto capítulo** estudia el efecto de la política monetaria expansiva actual sobre la rentabilidad bancaria utilizando una muestra de bancos de 31 países de la OCDE durante el período 2000-2017, que incluye los años de expansión económica, los años de crisis financiera y los años de la posterior recuperación económica. La estimación empírica se lleva a cabo con una estimación dinámica por el Método Generalizado de Momentos (MGM). Como variable dependiente se utiliza alternativamente el margen de intermediación y la rentabilidad de los activos (ROA). Como determinantes de estas variables se incluyen, además de la variable endógena retardada un periodo para controlar por la inercia en su nivel, el nivel de tipos de interés, la pendiente de la curva de tipos de interés, el índice de Lerner de poder de mercado (corregido por riesgo de crédito), el riesgo de crédito, el riesgo de tipo de interés, la interacción entre riesgos, el tamaño bancario, el grado de aversión al riesgo, los costes operativos (únicamente para el caso del margen de intermediación como variable dependiente, ya que en el caso de ROA la variable relativa a los costes operativos medios es una variable identidad), el pago de intereses

implícito, las reservas líquidas, la eficiencia en la gestión y el crecimiento del PIB. Además, se incluye el cuadrado tanto del nivel de tipos de interés como de la curva de tipos para capturar una posible relación no lineal. Se incluyen también efectos temporales para reflejar el impacto de *shocks* específicos de cada año que afectan a la variable dependiente.

Por tanto, se estiman las siguientes ecuaciones para el margen de intermediación y la rentabilidad, respectivamente, de un banco *i* en el año *t*:

$$
\begin{aligned}
&Margen\ de\ intermediación_{it} \\
&\quad = \beta_0 + \beta_1\ Margen\ de\ intermediación_{it-1} \\
&\quad + \beta_2\ Nivel\ de\ tipos\ de\ interés_{it} \\
&\quad + \ \beta_3\ Nivel\ de\ tipos\ de\ interés_{it}^2 \\
&\quad + \beta_4\ Pendiente\ de\ la\ curva\ de\ tipos_{it} \\
&\quad + \beta_5\ Pendiente\ de\ la\ curva\ de\ tipos_{it}^2 + \beta_6\ Índice\ de\ Lerner_{it} \\
&\quad + \beta_7\ Riego\ de\ crédito_{it} + \beta_8\ \ Riesgo\ de\ tipo\ de\ interés_{it} \\
&\quad + \beta_9\ Interacción\ entre\ riesgos_{it} + \beta_{10}\ Tamaño\ bancario_{it} \\
&\quad + \beta_{11}\ Grado\ de\ aversión\ al\ riesgo_{it} \\
&\quad + \beta_{12}\ Costes\ operativos\ medios_{it} \\
&\quad + \beta_{13}\ Pago\ implícito\ de\ intereses_{it} + \beta_{14}\ Reservas\ líquidas_{it} \\
&\quad + \ \beta_{15}\ Eficiencia_{it} + \beta_{16}\ Crecimiento\ del\ PIB_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
&Rentabilidad\ de\ los\ activos_{it} \\
&\quad = \beta_0 + \beta_1 Rentabilidad\ de\ los\ activos_{it-1} \\
&\quad + \beta_2\ Nivel\ de\ tipos\ de\ interés_{it} \\
&\quad + \ \beta_3\ Nivel\ de\ tipos\ de\ interés_{it}^2 \\
&\quad + \beta_4\ Pendiente\ de\ la\ curva\ de\ tipos_{it} \\
&\quad + \beta_5\ Pendiente\ de\ la\ curva\ de\ tipos_{it}^2 + \beta_6\ Índice\ de\ Lerner_{it} \\
&\quad + \beta_7\ Riego\ de\ crédito_{it} + \beta_8\ \ Riesgo\ de\ tipo\ de\ interés_{it} \\
&\quad + \beta_9\ Interacción\ entre\ riesgos_{it} + \beta_{10}\ Tamaño\ bancario_{it} \\
&\quad + \beta_{11}\ Grado\ de\ aversión\ al\ riesgo_{it} \\
&\quad + \beta_{12}\ Costes\ operativos\ medios_{it} \\
&\quad + \beta_{13}\ Pago\ implícito\ de\ intereses_{it} + \beta_{14}\ Reservas\ líquidas_{it} \\
&\quad + \ \beta_{15}\ Eficiencia_{it} + \beta_{16}\ Crecimiento\ del\ PIB_{it} + \varepsilon_i + \alpha_t + u_{it}
\end{aligned}
\tag{3}
$$

donde ε_i son los efectos individuales, α_t los efectos temporales y u_{it} la perturbación aleatoria.

Los resultados muestran que las medidas de política monetaria expansivas tienen un impacto negativo en los márgenes de intermediación y, por tanto, en la rentabilidad bancaria, a través de los bajos tipos de interés y el aplanamiento de la curva de tipos. La relación entre el tipo de interés y el margen de intermediación no es lineal. Esto refleja, entre otras cosas, que cuando los tipos de interés son bajos, dado que el tipo de interés de los depósitos no puede caer por debajo de cero, la diferencia entre el tipo de interés de los préstamos y el de los depósitos se reduce, siendo esta reducción mayor a medida que baja el tipo de interés. Lo mismo ocurre con la relación entre el tipo de interés y la rentabilidad. En el caso de la curva de tipos de interés, la relación tampoco es lineal, ni con el margen de intermediación ni con la rentabilidad. Cuanto más plana es la

pendiente de la curva de tipos, la reducción del margen de intermediación y la rentabilidad es mayor. Por lo tanto, el problema de baja rentabilidad que sufren ciertos sectores bancarios persistirá mientras continúe el escenario actual de bajos tipos de interés, lo que podía llegar a afectar a la estabilidad financiera.

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